US009415645B2

(12) **United States Patent**
Racine et al.

(10) **Patent No.: US 9,415,645 B2**
(45) **Date of Patent: Aug. 16, 2016**

(54) **VALVE ASSEMBLY FOR A CENTRAL TIRE INFLATION SYSTEM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 107 days.

(21) Appl. No.: **14/177,574**

(22) Filed: **Feb. 11, 2014**

(65) **Prior Publication Data**

US 2014/0224352 A1 Aug. 14, 2014

Related U.S. Application Data

(60) Provisional application No. 61/763,048, filed on Feb. 11, 2013, provisional application No. 61/776,431, filed on Mar. 11, 2013, provisional application No. 61/792,778, filed on Mar. 15, 2013, provisional application No. 61/865,790, filed on Aug. 14, 2013, provisional application No. 61/925,749, filed on Jan. 10, 2014.

(51) **Int. Cl.**

F16K 15/20	(2006.01)
B60C 29/00	(2006.01)
B60C 23/00	(2006.01)

(52) **U.S. Cl.**
CPC ***B60C 29/002*** (2013.04); ***B60C 23/003*** (2013.01); *Y10T 137/3584* (2015.04); *Y10T 137/3631* (2015.04); *Y10T 137/88062* (2015.04)

(58) **Field of Classification Search**
CPC Y10T 137/3631; Y10T 137/3646; Y10T 137/7779; Y10T 137/778; Y10T 137/7847; Y10T 137/7848
USPC 138/46
See application file for complete search history.

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Primary Examiner — R. K. Arundale
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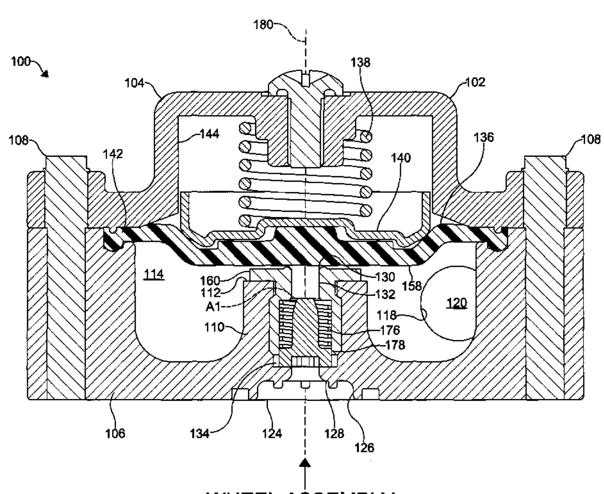
(57) **ABSTRACT**

A valve assembly for a central tire inflation system is provided. The valve assembly includes a first housing having a first port connected to a second port via a cavity. The second port is in fluid communication with a wheel assembly. A biasing member is disposed in the cavity adjacent a first perforation formed in the first housing. A valve member is contacted by the biasing member. The valve member includes a first portion having an outer surface which is unbroken adjacent an end to allow a pressurized fluid to flow around it. The first portion reduces in diameter toward the end.

19 Claims, 18 Drawing Sheets



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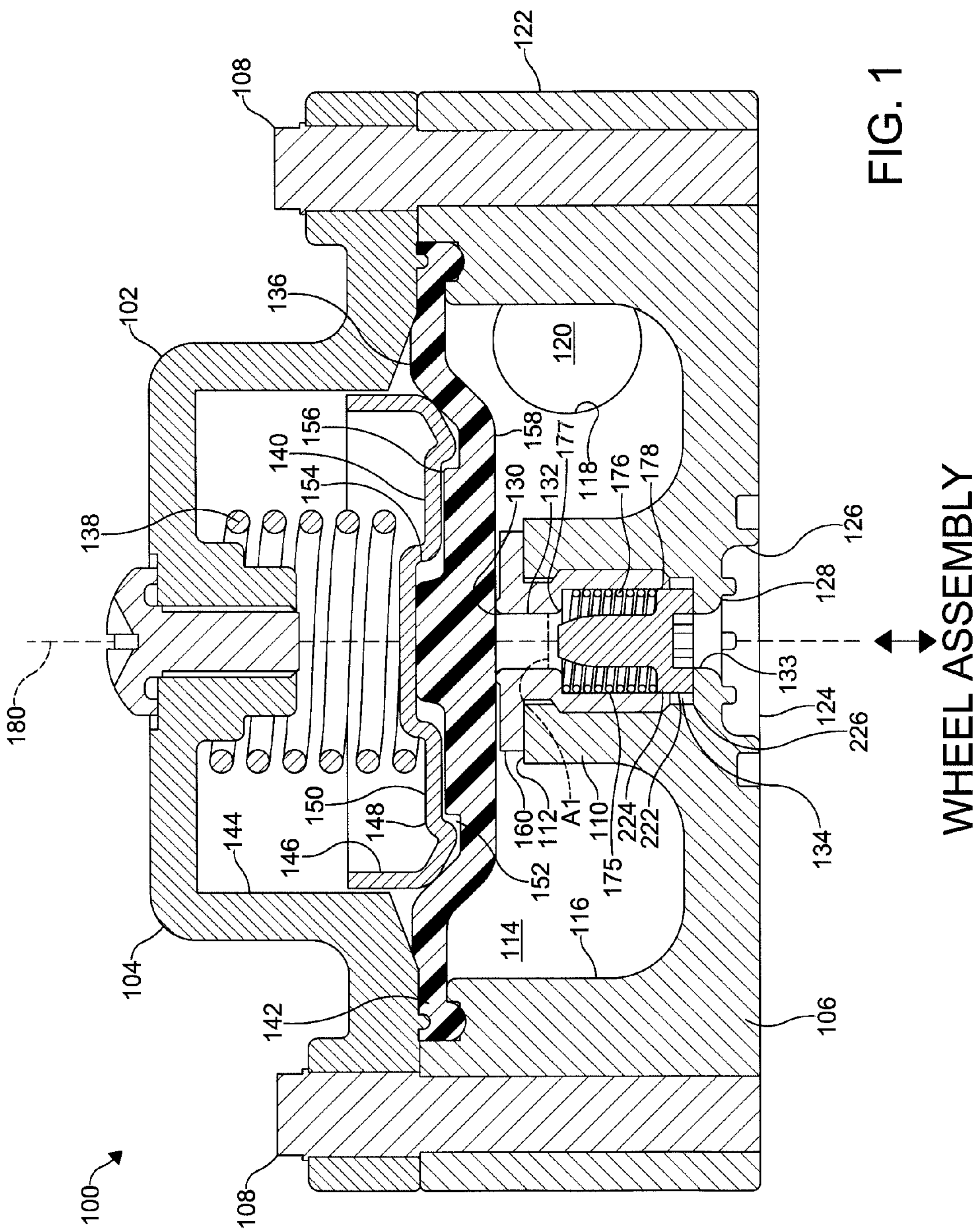

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WHEEL ASSEMBLY

FIG. 1

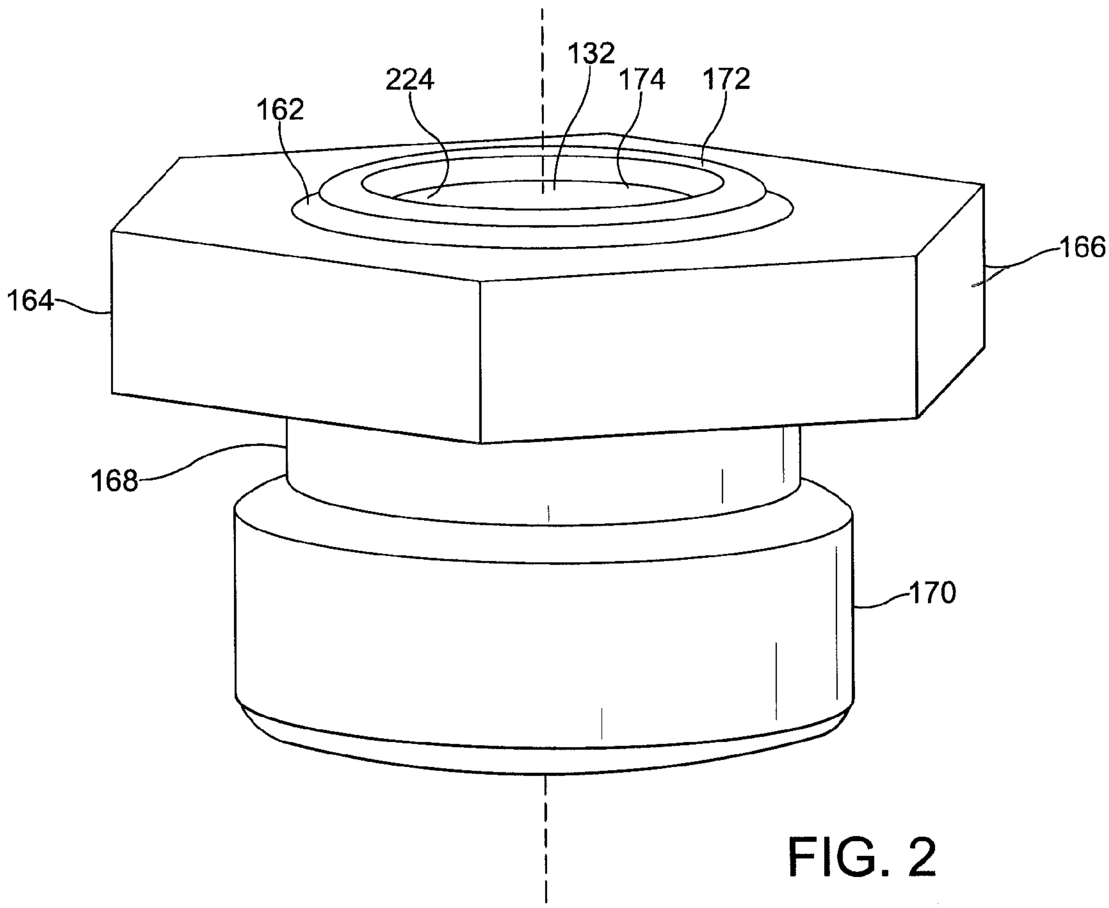

FIG. 2

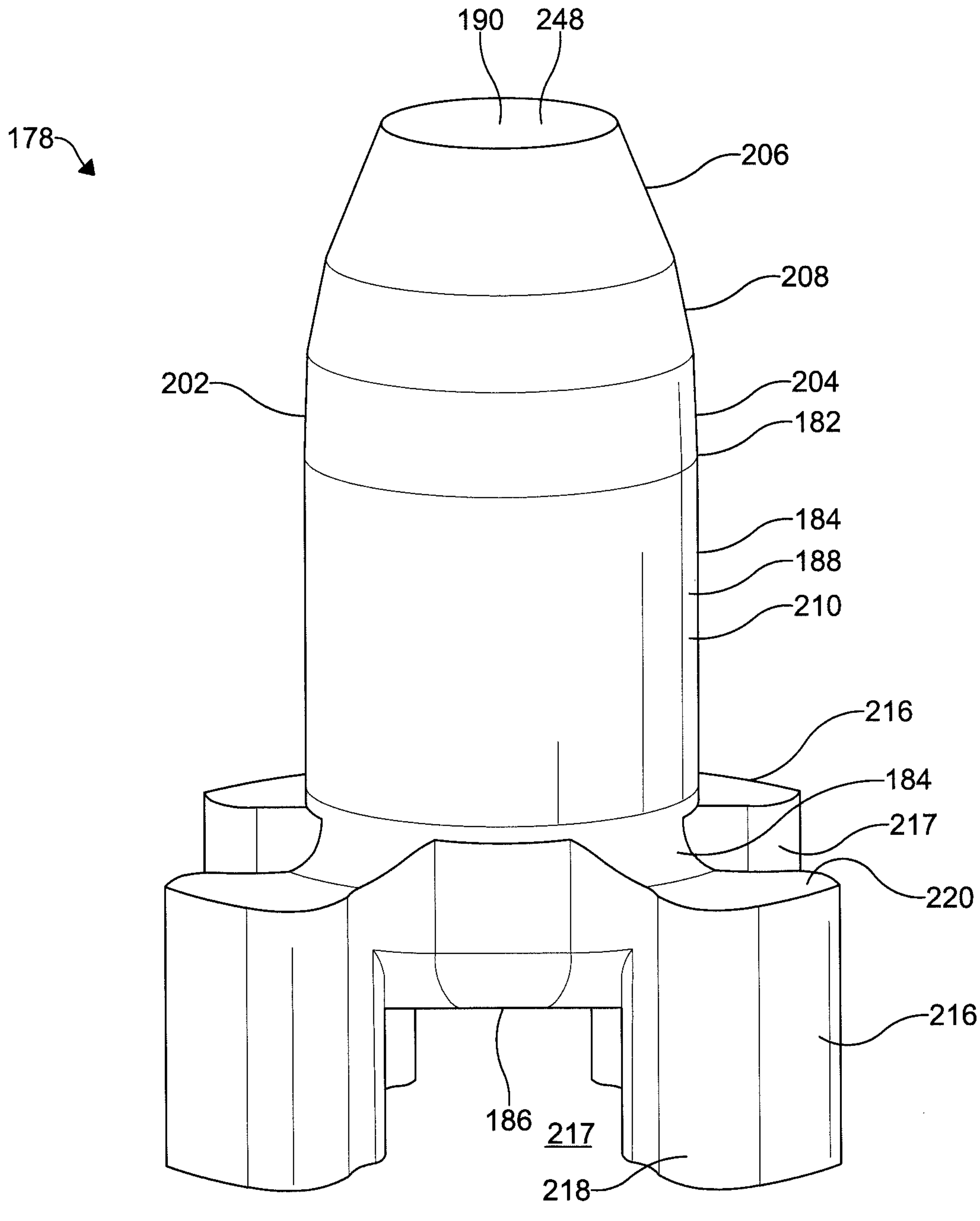
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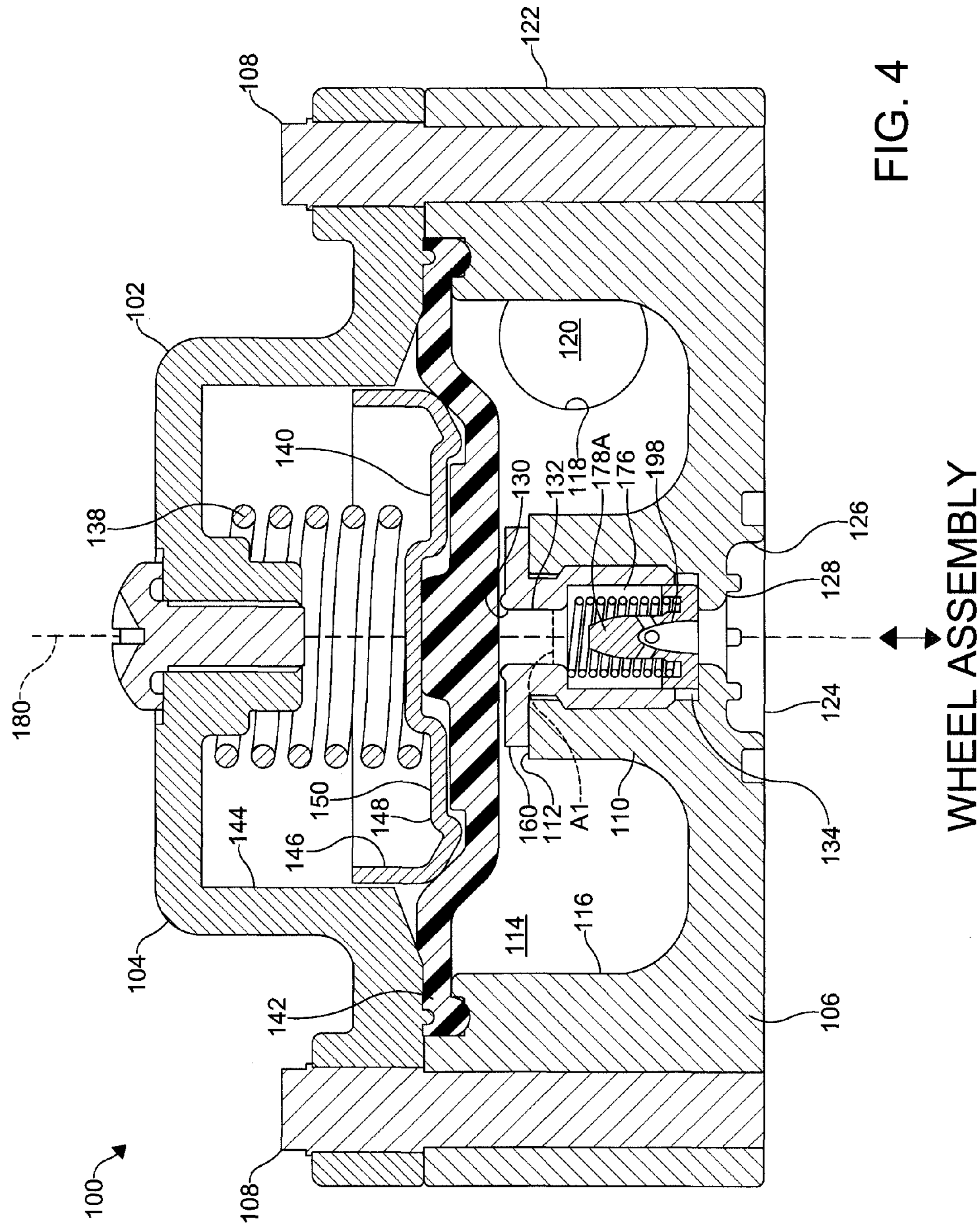
FIG. 3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WHEEL ASSEMBLY

FIG. 4

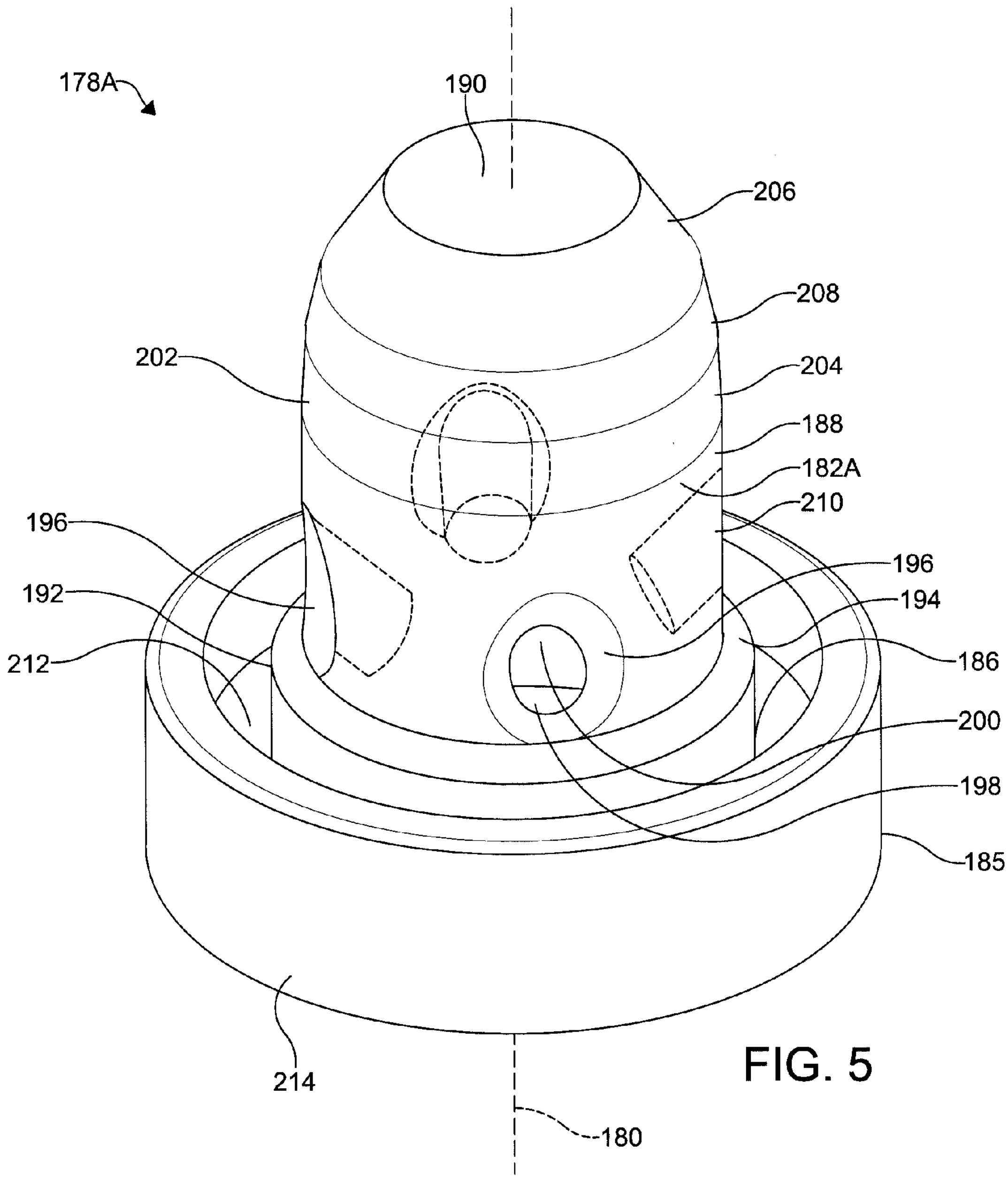
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FIG. 5

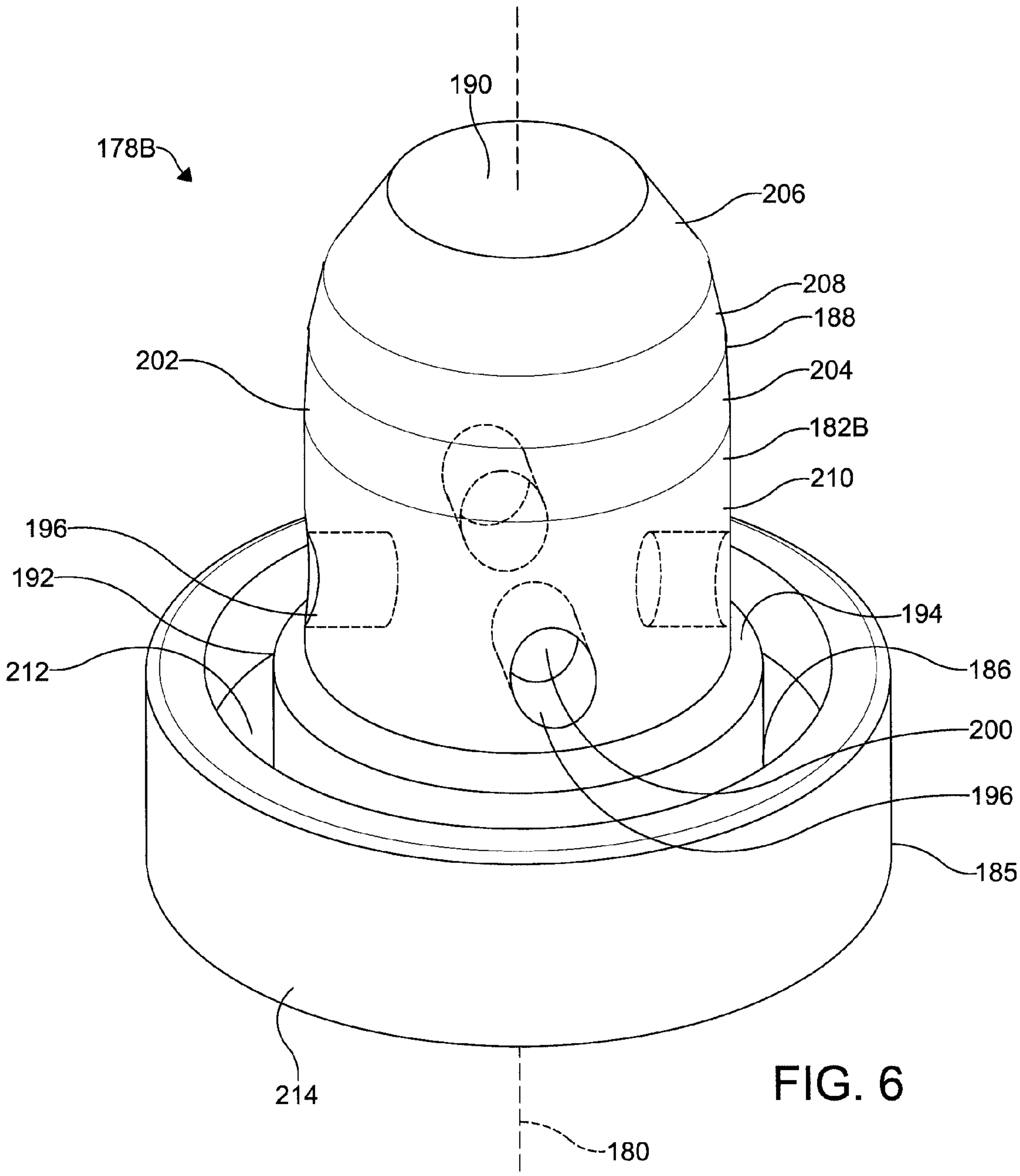
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FIG. 6

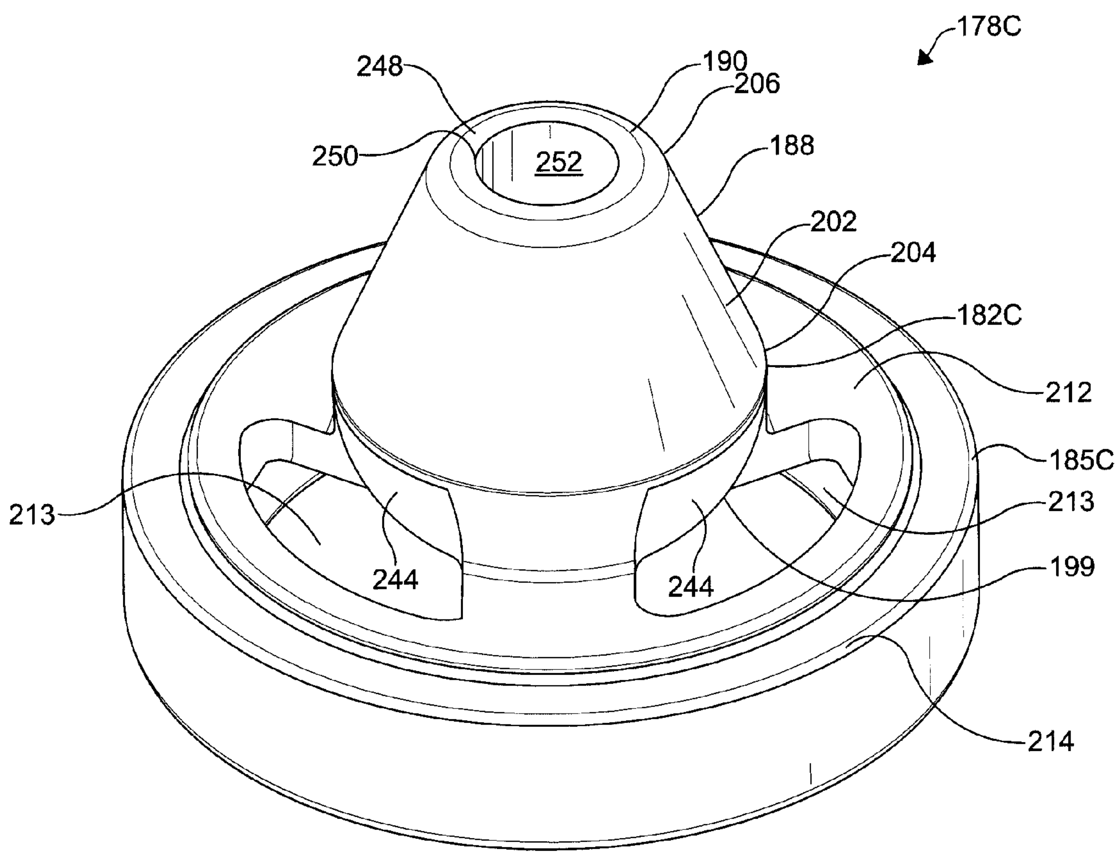
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FIG. 7

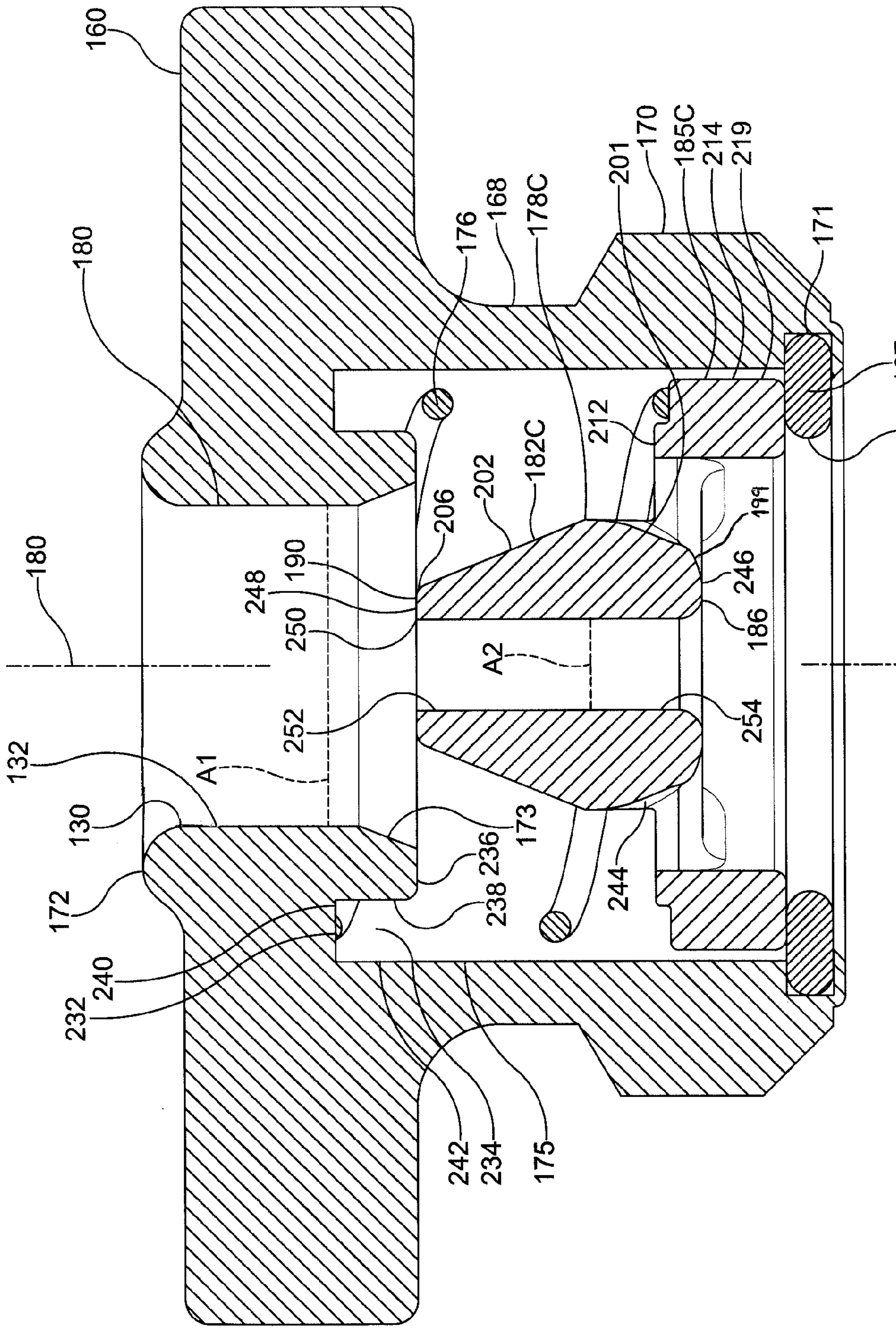
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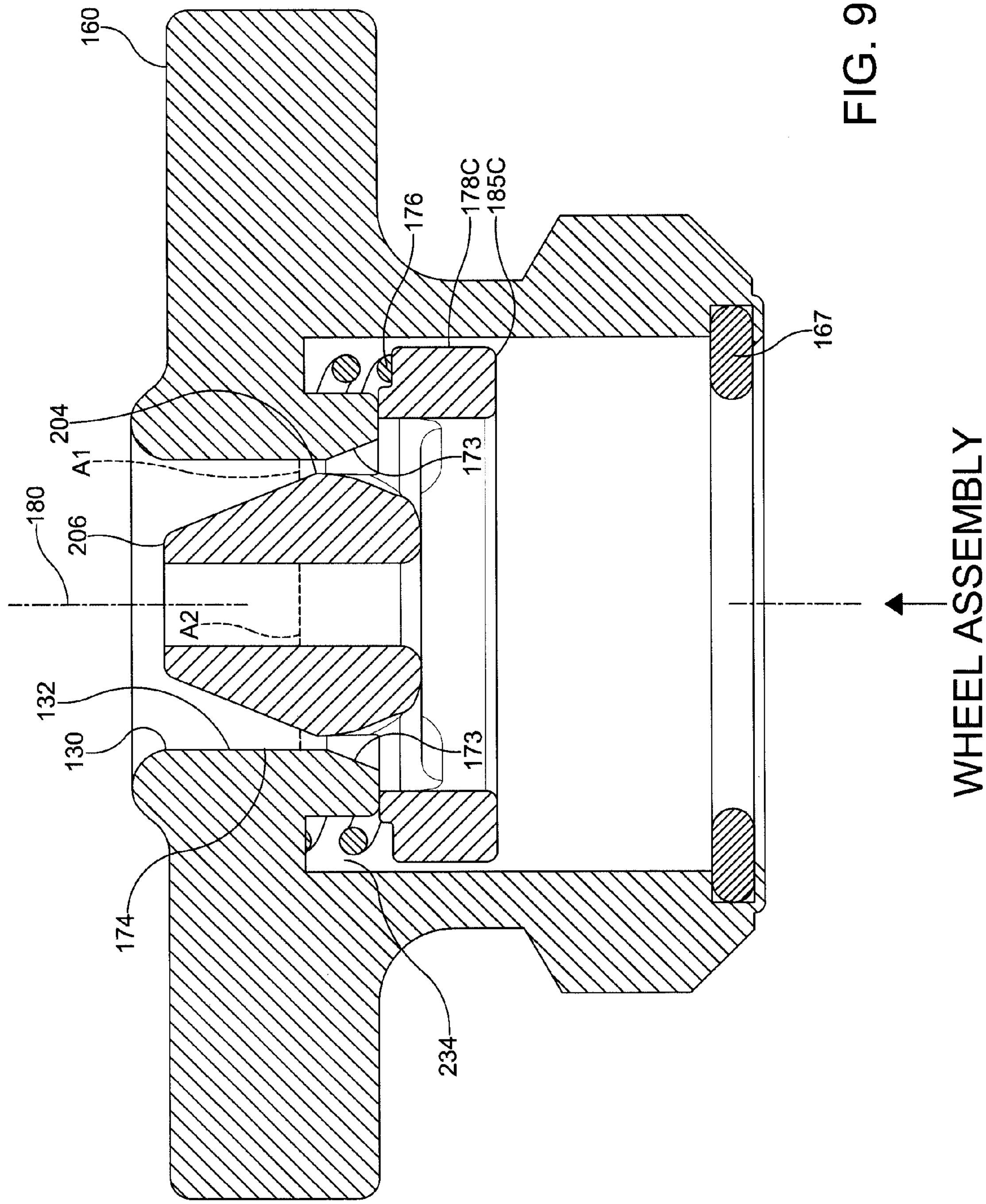
FIG. 8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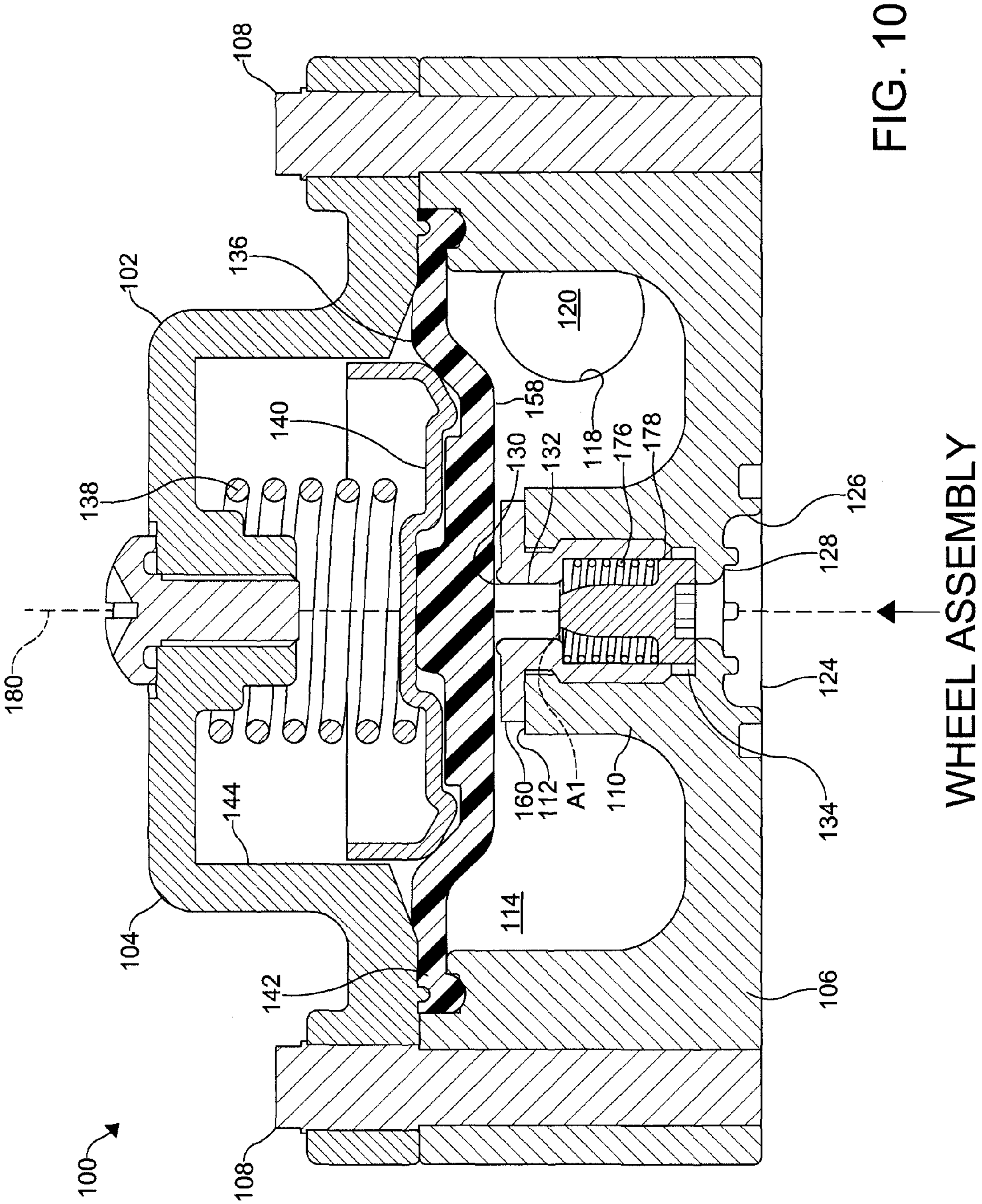
WHEEL ASSEMBLY

FIG. 9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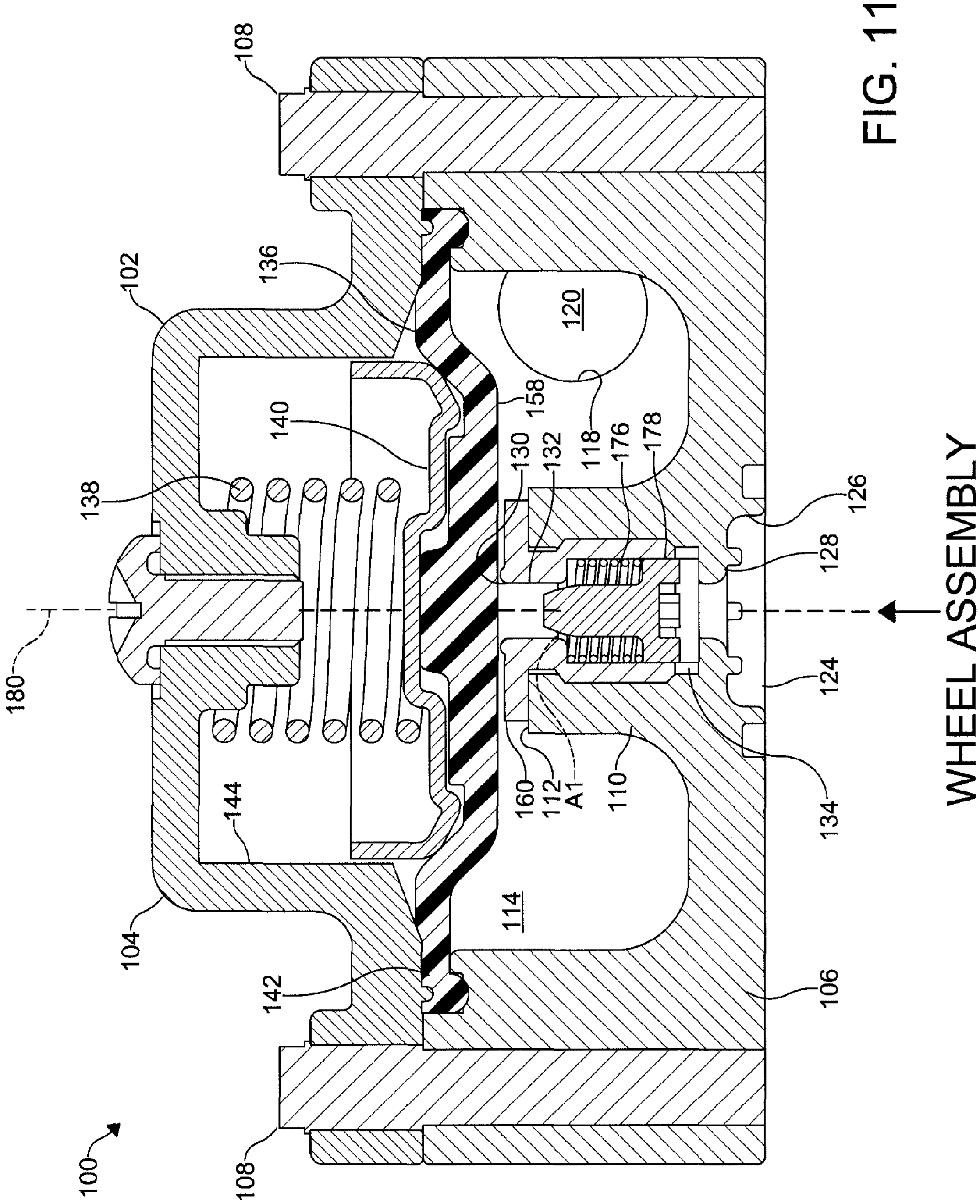
WHEEL ASSEMBLY

FIG. 10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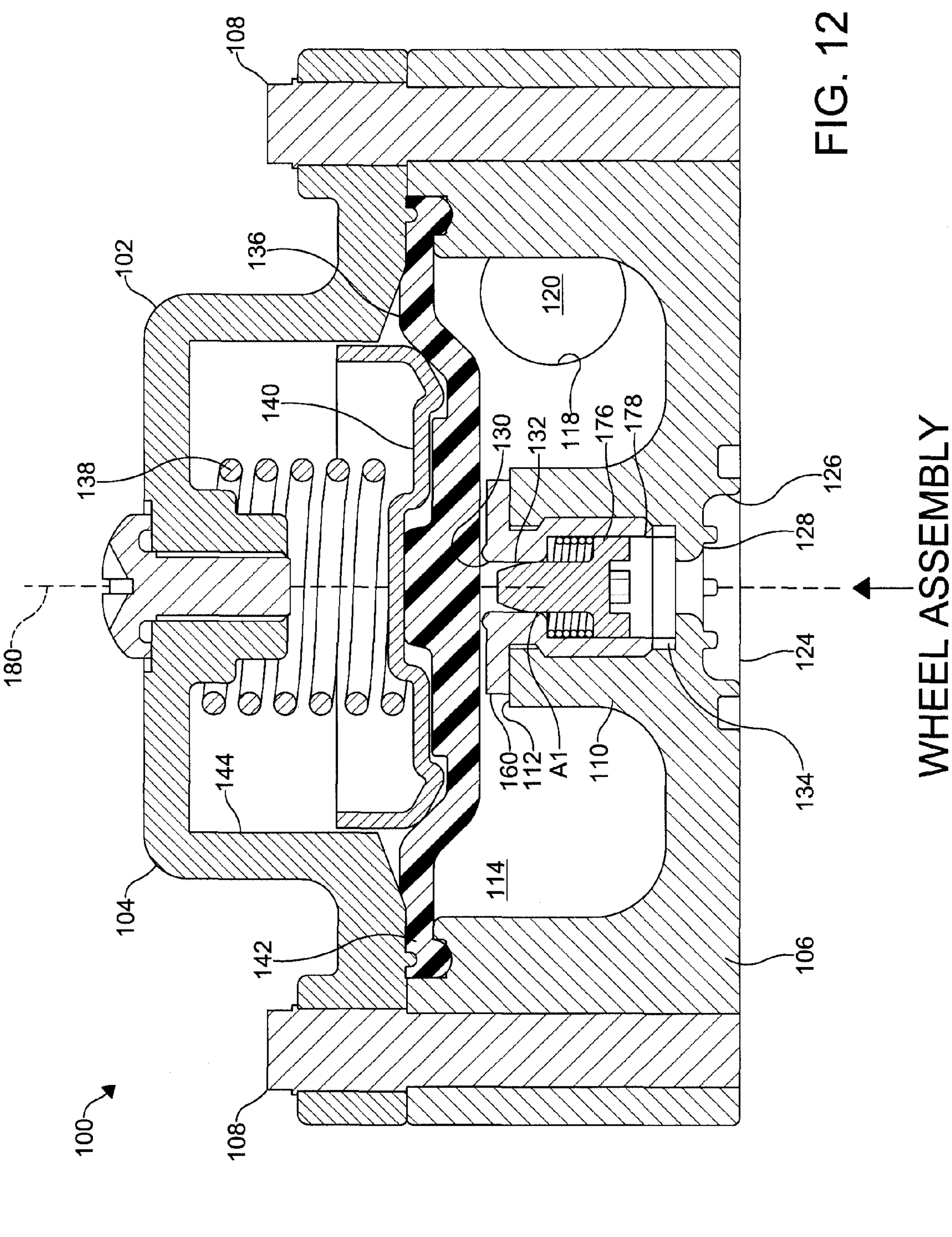
WHEEL ASSEMBLY

FIG. 11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WHEEL ASSEMBLY

FIG. 12

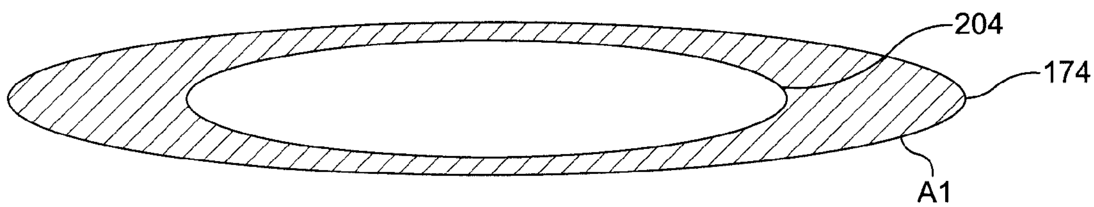


FIG. 13

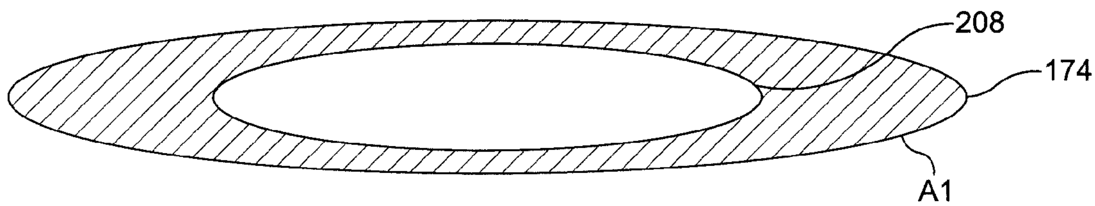


FIG. 14

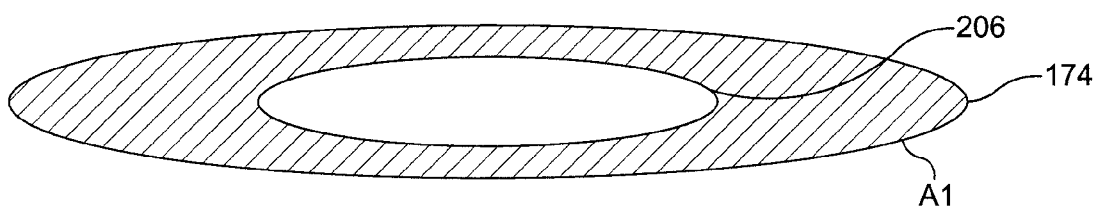
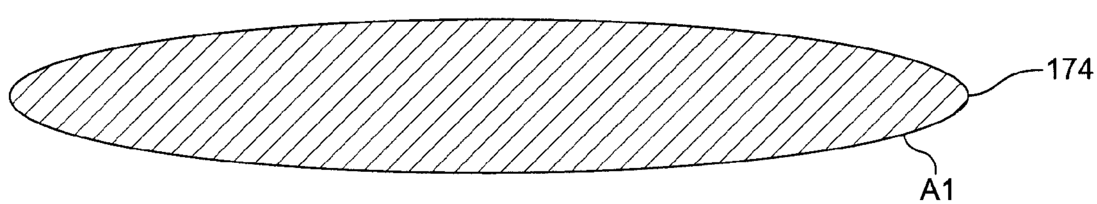


FIG. 15



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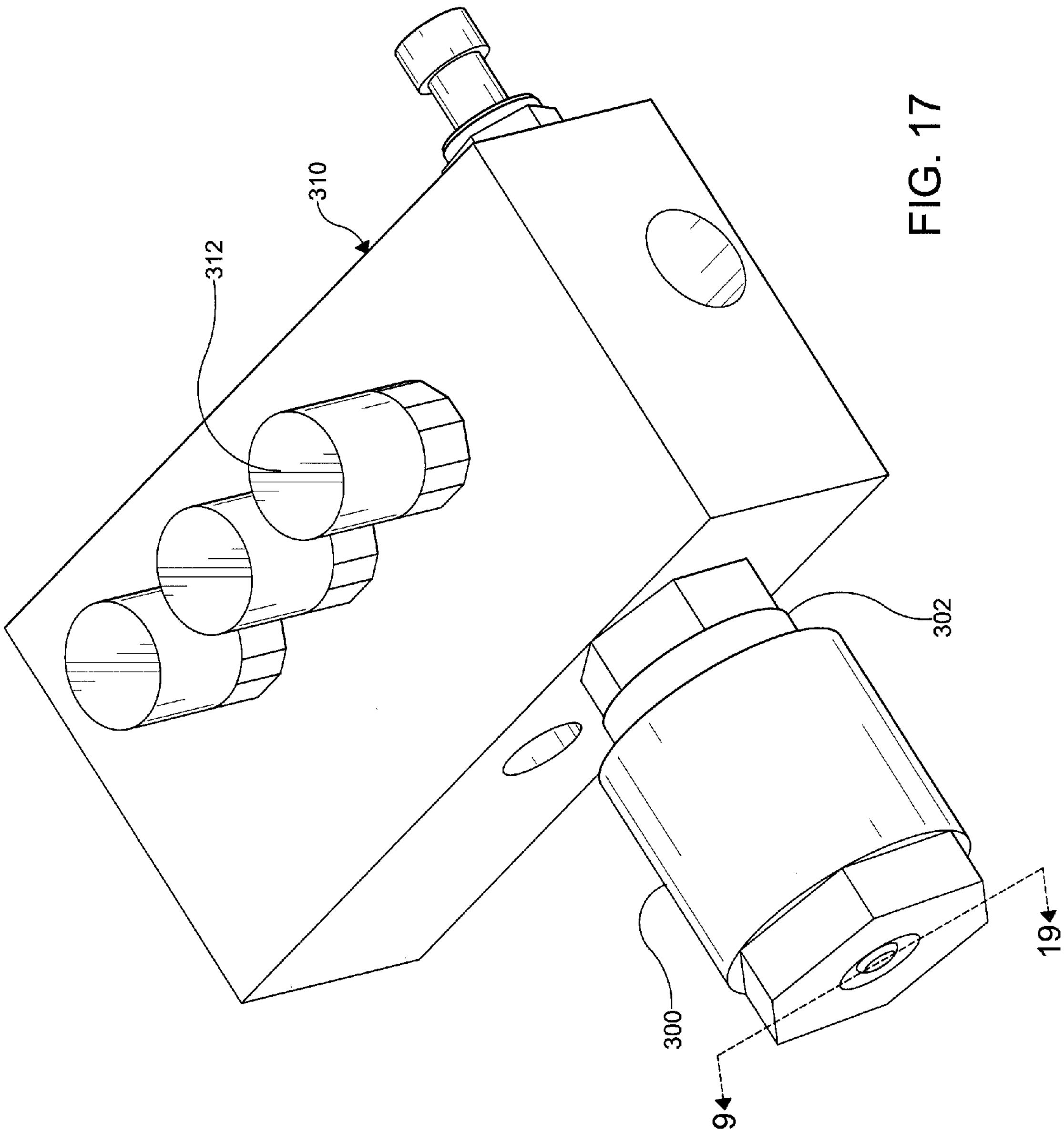


FIG. 17

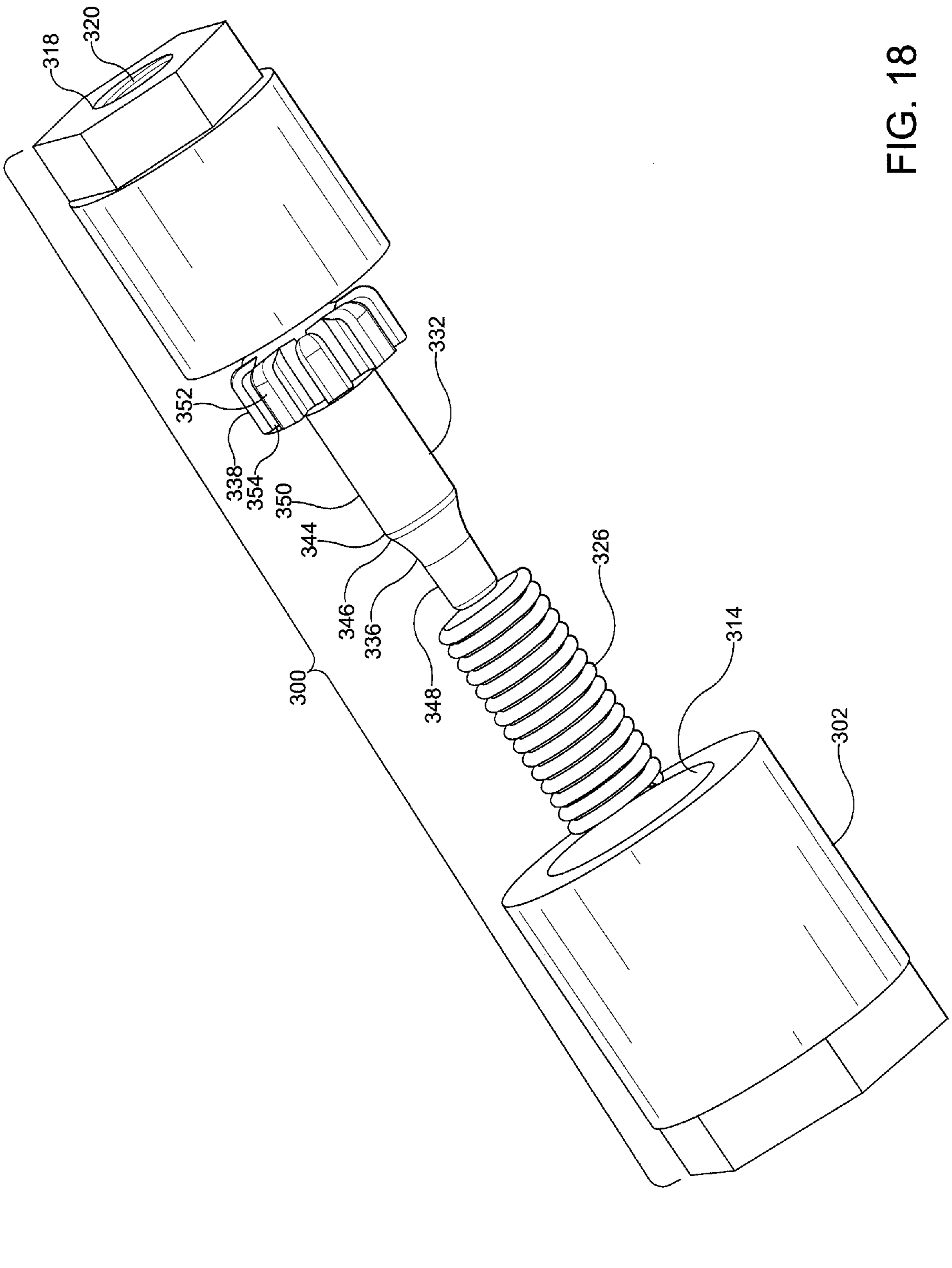
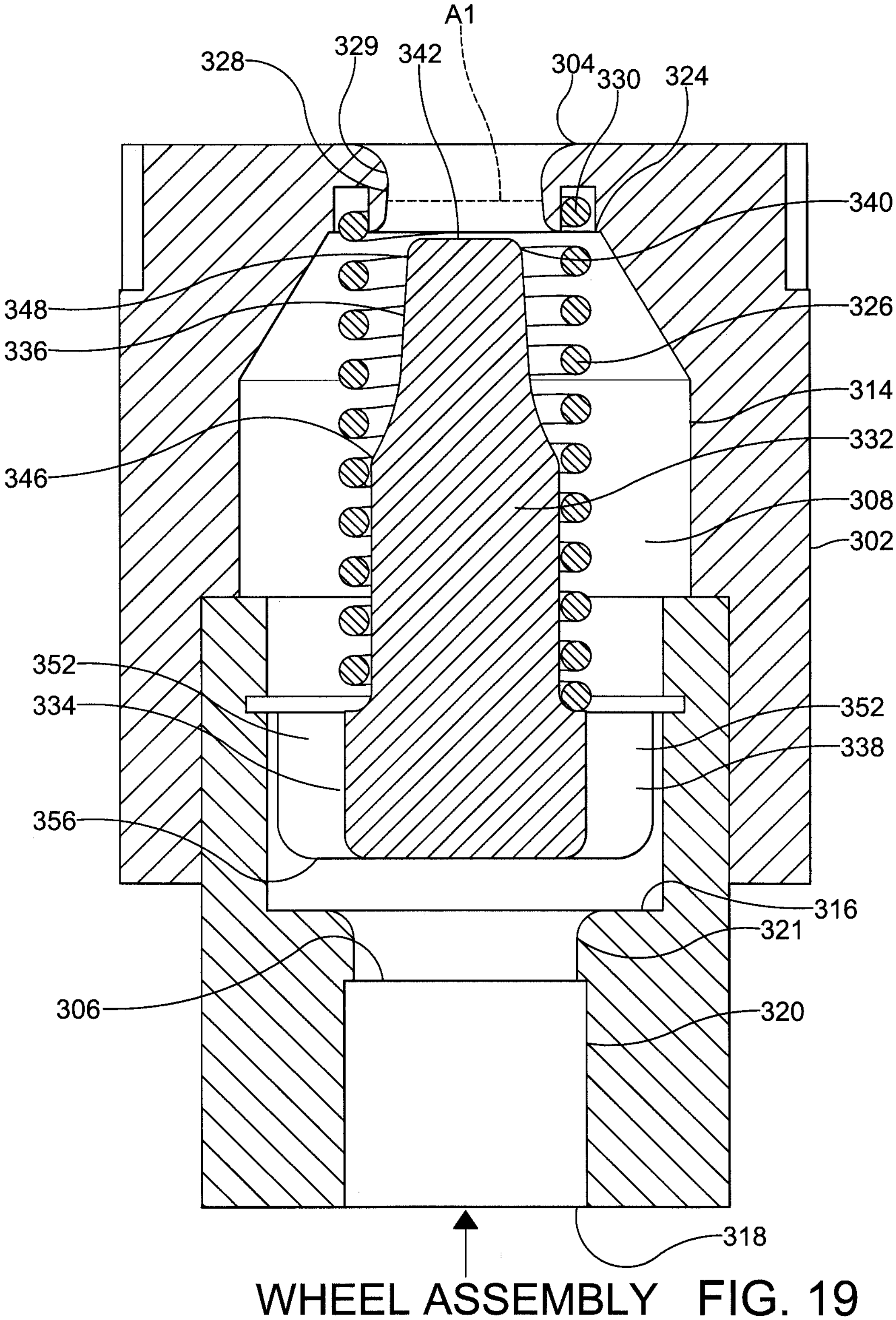


FIG. 18



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WHEEL ASSEMBLY

FIG. 19

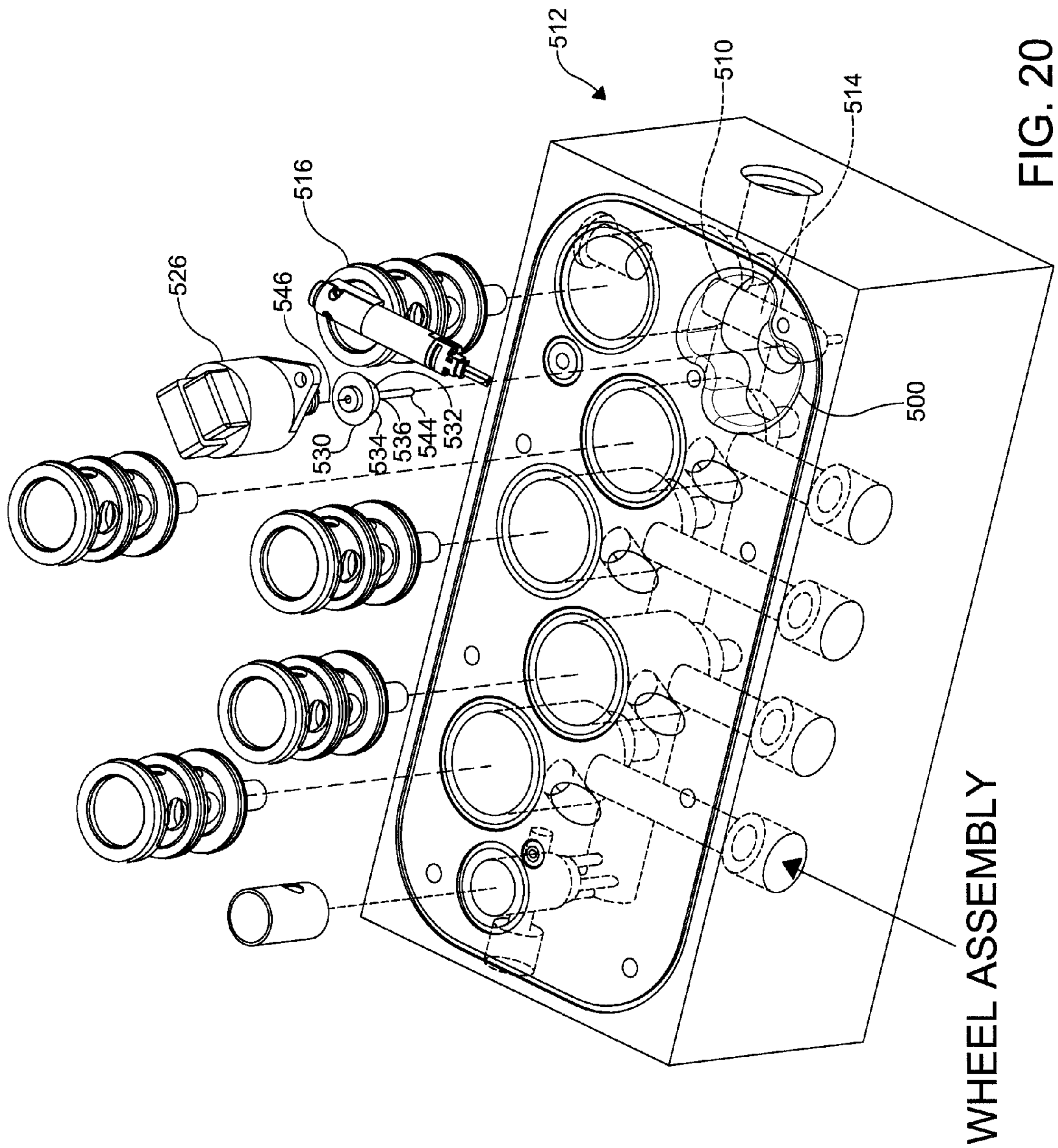

FIG. 20

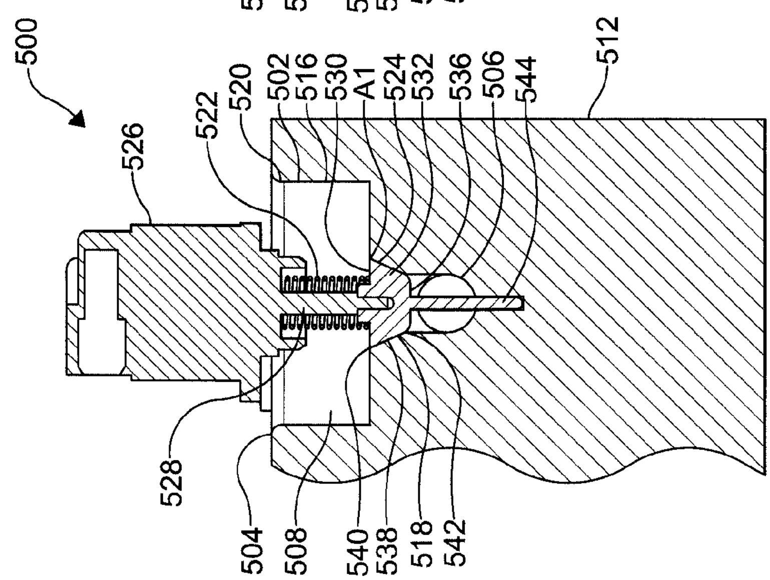

FIG. 21

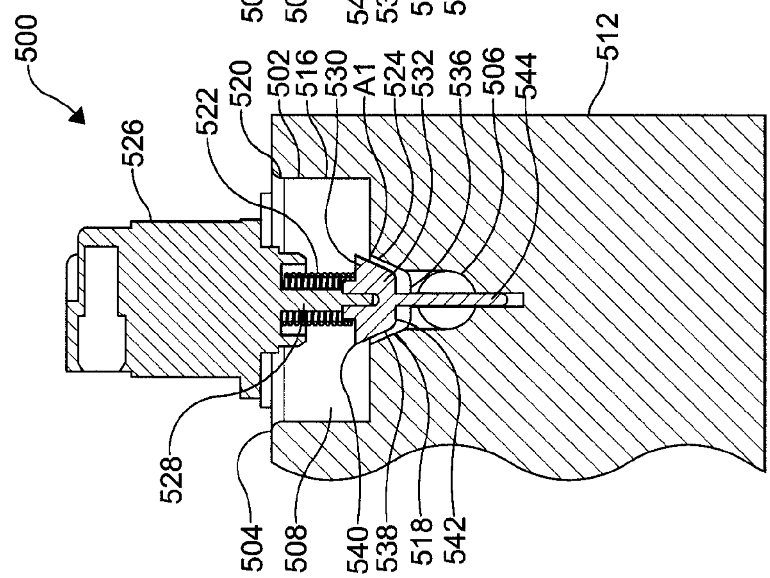

FIG. 22

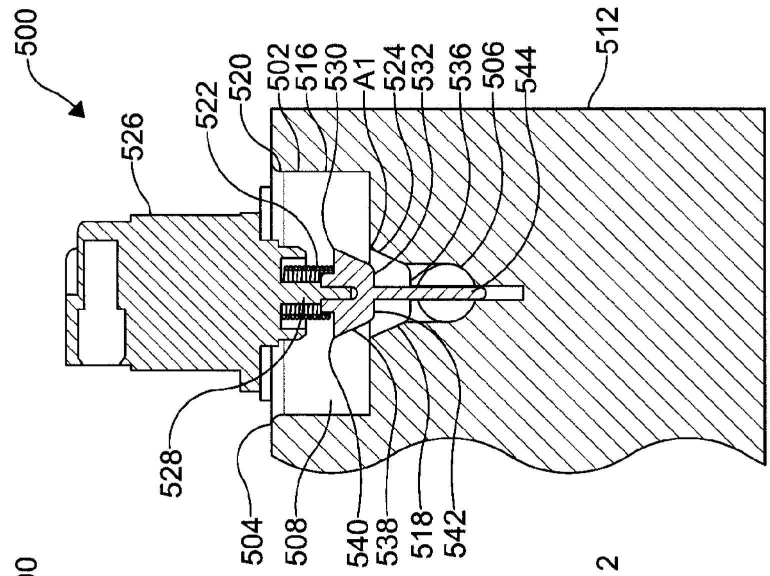

FIG. 23

VALVE ASSEMBLY FOR A CENTRAL TIRE INFLATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is claiming the benefit, under 35 U.S.C. 119(e), of the provisional applications granted Ser. Nos. 61/763,048 filed on Feb. 11, 2013, 61/776,431 filed on Mar. 11, 2013, 61/792,778 filed on Mar. 15, 2013, 61/865,790 filed on Aug. 14, 2013 and 61/925,749 filed on Jan. 10, 2014 the entire disclosures of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

The invention relates to a valve assembly. More specifically, the invention relates to a valve assembly for a central tire inflation system.

Current valve designs used in tire inflation systems have minimum and maximum pressure limits which are a function of the operational temperature requirements and the backpressure characteristics of the system. As the flow through the tire inflation system increases, backpressure in the system increases. At higher flow rates and backpressures, the pressure experienced by current valve designs can be such that the valve cannot close when the tire pressure has been adjusted to a selected value.

Therefore, it would be desirable to provide a valve assembly which can effectively function at high flow rates and backpressures and that overcomes the aforementioned disadvantages.

BRIEF SUMMARY OF THE INVENTION

A valve assembly for a central tire inflation system is provided. The valve assembly comprises a first housing having a first port connected to a second port via a cavity. The second port is in fluid communication with a wheel assembly. A biasing member is disposed in the cavity adjacent a first perforation formed in the first housing. The valve assembly also comprises a valve member contacted by the biasing member. The valve member comprises a first portion having an outer surface which is unbroken adjacent an end to allow a pressurized fluid to flow around it. The first portion reduces in diameter toward the end.

BRIEF DESCRIPTION OF THE DRAWINGS

The above, as well as other advantages of the present invention will become readily apparent to those skilled in the art from the following detailed description when considered in the light of the accompanying drawings in which:

FIG. **1** is a cross-sectional view of an embodiment of a valve assembly in accordance with the invention;

FIG. **2** is a perspective view of an embodiment of the first housing of the valve assembly of FIG. **1**;

FIG. **3** is a perspective view of an embodiment of the valve member of the valve assembly of FIG. **1**;

FIG. **4** is a cross-sectional view of another embodiment of the valve assembly in accordance with the invention;

FIG. **5** is a perspective view of an embodiment of the valve member of the valve assembly of FIG. **4**;

FIG. **6** is a perspective view of another embodiment of a valve member suitable for use in the valve assemblies of FIGS. **1** and **4**;

FIG. **7** is a perspective view of another embodiment of a valve member suitable for in the valve assemblies of FIGS. **1** and **4**;

FIG. **8** is a cross-sectional view of the valve member of FIG. **7** and another embodiment of a first housing suitable for in the valve assemblies of FIGS. **1** and **4**;

FIG. **9** is another cross-sectional view of the valve member and the first housing illustrated in FIG. **8** when the tire pressure is being decreased;

FIG. **10** is a cross-sectional view of an embodiment of the valve assembly of FIG. **1** when the tire pressure is being decreased;

FIG. **11** is a cross-sectional view of an embodiment of the valve assembly of FIG. **1** when the tire pressure is being decreased;

FIG. **12** is a cross-sectional view of an embodiment of the valve assembly of FIG. **1** when the tire pressure is being decreased;

FIG. **13** is a perspective view of an area within the valve assembly of FIG. **12**;

FIG. **14** is a perspective view of an area within the valve assembly of FIG. **11**;

FIG. **15** is a perspective view of an area within the valve assembly of FIG. **10**;

FIG. **16** is a perspective view of an area within the valve assembly of FIG. **1** or the area when the tire pressure is low and being decreased;

FIG. **17** is a perspective view of another embodiment of the valve assembly in accordance with the invention which is shown attached to a pneumatic control unit;

FIG. **18** is an exploded perspective view of the valve assembly of FIG. **17**;

FIG. **19** is a cross-sectional view of the valve assembly of FIG. **17**;

FIG. **20** is an exploded perspective view of another embodiment of the valve assembly in accordance with the invention and portions of another pneumatic control unit;

FIG. **21** depicts a sectional view of the valve assembly of FIG. **20** when the tire pressure is being decreased;

FIG. **22** depicts a sectional view of the valve assembly of FIG. **20** when the tire pressure is being decreased; and

FIG. **23** depicts a sectional view of the valve assembly of FIG. **20** when the tire pressure is being decreased.

DETAILED DESCRIPTION OF THE INVENTION

It is to be understood that the invention may assume various alternative orientations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific assemblies and features illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts. Hence, specific dimensions, directions, or other physical characteristics relating to the embodiments disclosed are not to be considered as limiting, unless expressly stated otherwise. Also, although they may not be, like elements in various embodiments may be commonly referred to with like reference numerals within this section of the application.

Embodiments of a valve assembly **100**, **300**, **500** are described herein. It would be understood by one of ordinary skill in the art that the valve assembly **100**, **300**, **500** may have applications to passenger, commercial and off-highway vehicles. Also, it would be understood by one of ordinary skill in the art that the embodiments of the valve assembly **100**, **300**, **500** could have industrial, locomotive, military and aerospace applications.

The valve assembly **100**, **300**, **500** will be described for use with air. However, the valve assembly is not limited to use with air. Thus, alternative gaseous fluids are suitable for use with the valve assembly.

Preferably, the valve assembly **100**, **300**, **500** is provided as a part of a central tire inflation system (CTIS). Conventional central tire inflation systems are known in the art and the valve assembly **100**, **300**, **500** may be utilized as a portion thereof. Additionally, portions of a central tire inflation system will be discussed herein for describing certain embodiments of the valve assembly **100**, **300**, **500**.

The central tire inflation system is provided on a vehicle (not depicted) to allow the operator to adjust (increase, decrease or maintain) the tire pressure of one or more wheel assemblies attached to the vehicle. Each wheel assembly comprises a tire and a wheel rim. The tire may be conventional in the art. The tire comprises an inner surface and an outer surface. A portion of the inner surface faces the wheel rim. The wheel rim may be conventional in the art. The wheel rim comprises an inner surface and an outer surface. Preferably, the tire is sealingly attached to the outer surface of the wheel rim.

Attaching the tire to the wheel rim forms a space which houses air. It should be appreciated that the space may house alternative fluids. Preferably, the air is pressurized. Within the space, air may be at a pressure from about 2 to 180 psi. The pressure exerted by the air in the space is referred to herein as tire pressure.

Utilizing the central tire inflation system, the tire pressure can be selected to be a desired value. In certain embodiments, it may be desired that the tire pressure is maintained at about 150 psi or less. The tire pressure can also be adjusted by increasing or decreasing the tire pressure. For example, the tire pressure may be adjusted from 150 psi to 10 psi or vice versa. The valve assembly **100**, **300**, **500** is utilized to adjust the desired tire pressure quickly over a wide range of flow rates and at high backpressure.

In order to achieve a desired tire pressure and/or adjust the tire pressure, the valve assembly **100**, **300**, **500** may be in or may be placed in fluid communication with another portion of the tire inflation system such as, for example, one or more fluid conduits, a rotary joint, another valve device/assembly and/or a pneumatic control unit. Additionally, the valve assembly **100**, **300**, **500** may be in or may be placed in fluid communication with the wheel assembly. Preferably, the valve assembly **100**, **300**, **500** is connected to the wheel assembly via a fluid conduit to permit fluid communication therewith.

Embodiments of the valve assembly **100** will now be described with reference to FIGS. **1-16**.

The valve assembly **100** is preferably utilized as a wheel valve or as a portion of the wheel valve. Advantageously, in these embodiments, the valve assembly **100** allows the tire pressure to be adjusted and closes when a selected tire pressure is achieved even at high flow rates and high backpressures. Preferably, in these embodiments, the valve assembly **100** is attached to the wheel assembly. For example, the valve assembly **100** may be attached to the outer surface or the inner surface of the wheel rim. Alternatively, the valve assembly **100** may be attached to an inboard surface or an outboard surface of the wheel rim.

The valve assembly **100** may comprise a second housing **102**. Preferably, the second housing **102** is attached to the wheel assembly and comprises a first portion **104** and a second portion **106**. The first portion **104** and second portion **106** may be attached to each other by one or more fasteners **108**. When the second housing **102** is attached to a wheel assembly, the second portion **106** separates the first portion **104** from the wheel assembly. The second portion **106** comprises a receiving portion **110** which has a mounting portion **112**.

A major chamber **114** is defined by inner surfaces **116**, **144** of the second housing **102**. A control port **118** is in fluid communication with the major chamber **114**. The control port **118** may also be in fluid communication with the other portions of the central tire inflation system such as a source of pressurized air (not depicted). In this embodiment, the source of pressurized air may be an air compressor provided on the vehicle and as a portion of the central tire inflation system. The control port **118** is in fluid communication with the major chamber **114** via a major fluid conduit **120**. The major fluid conduit **120** extends from an outer surface **122** of the second housing **102** to the major chamber **114**.

The major fluid conduit **120** may be provided in a parallel relationship with the receiving portion **110**. However, in another embodiment, the major fluid conduit **120** is provided in a perpendicular relationship with the receiving portion **110**. The major fluid conduit **120** may comprise portions which are of different diameters and lengths.

The major chamber **114** may also selectively be in fluid communication with a tire port **124** via a valve device **136**. The tire port **124** is in fluid communication with the pressurized air in the wheel assembly. In these embodiments, air within the wheel assembly is expelled through the tire port **124** when the tire pressure is decreased and enters the wheel assembly through the tire port **124** when the tire pressure is increased. The tire port **124** is selectively in fluid communication with the control port **118** via the major chamber **124** and major fluid conduit **120**. The tire port **124** is in fluid communication with a second port **128** via a fluid conduit **126** attached to the second port **128**. The second port **128** is in fluid communication with and connected to a first port **130** via a cavity **134**. The cavity **134** is connected to the second port **128** via a second fluid conduit **133** provided therebetween. The cavity **134** is connected to the first port **130** via a first perforation **132** which is provided therebetween. The first perforation **132** is attached to the first port **130** on an end and the cavity **134** on an opposite end.

The first port **130** is in fluid communication with the valve device **136**. The valve device **136** is positioned over the first port **130** and is operable from an open position to a closed position and vice versa. The valve device **136** allows or prevents fluid communication between the major chamber **114** and first port **130**. In these embodiments, the valve device **136** is positioned within the second housing **102**. The valve device **136** comprises a major biasing member **138**, a backing plate **140** and a diaphragm portion **142**. The major biasing member **138**, backing plate **140** and diaphragm portion **142** are concentric.

The major biasing member **138** is disposed within the chamber **114** abutting the first portion **104** of the second housing **102**. The major biasing member **138** may be a spring such as, for example, a coil spring. The major biasing member **138** is disposed between the inner surface **144** of the second housing **102** and the backing plate **140**. The major biasing member **138** contacts the backing plate **140** and biases the valve device **136** toward the tire port **124** and to the closed position.

The backing plate **140** comprises a major wall portion **146** and a disk portion **148**. The major wall portion **146** is attached to and generally extends away from the disk portion **148**. The major wall portion **146** is disposed adjacent the first portion **104** of the housing **102**. The disk portion **148** comprises a biasing surface **150** and a mating surface **152**. The biasing surface **150** is contacted by the major biasing member **138**.

The mating surface **152** defines a groove **154** which receives a portion of the diaphragm portion **142**.

The diaphragm portion **142** is generally disk-shaped and may be formed from rubber or another elastomeric material. The diaphragm portion **142** comprises a first surface **156** and a second surface **158**. The first surface **156** is in contact with the backing plate **140** and is received by the groove **154**. The second surface **158** contacts a first housing **160** to provide a seal over the first port **130** when the valve device **136** is in the closed position.

The valve device **136** is in fluid communication with the control port **118** via the major chamber **114** and major fluid conduit **120**. Also, the valve device **136** is in fluid communication with the first perforation **132** via the first port **130**. The valve device **136** selectively allows or prevents fluid communication between the wheel assembly and the air compressor. In the open position, the valve device **136** allows fluid communication between the control port **118** and the tire port **124**. In the closed position, the valve device **136** prevents fluid communication between the control port **118** and the tire port **124** by providing the seal over the first port **130**.

The valve assembly **100** comprises a first housing **160**. In the embodiments of FIGS. **1-16**, the first housing **160** is positioned within the second housing **102** between the diaphragm portion **142** and the receiving portion **110**. In these embodiments, the first housing **160** is received by the receiving portion **110** and a portion of the first housing **160** is disposed therein.

As shown best in FIG. **2**, the first housing **160** may comprise a center portion **162** and a flange portion **164**. The center portion **162** and the flange portion **164** are concentric. The flange portion **164** is attached to the center portion **162** and extends away therefrom. The flange portion **164** may comprise a plurality of outer surfaces **166** which may define a hexagonal shape. Referring back to FIG. **1**, the flange portion **164** mates with the mounting portion **112** so that the position the first housing **160** is maintained relative to the receiving portion **110**.

Referring back to FIG. **2**, the center portion **162** comprises a small diameter portion **168** and a large diameter portion **170**. The small diameter portion **168** and the large diameter portion **170** are attached to each other and are concentric. The center portion **162** also comprises a lip **172** attached to the small diameter portion **168**. As illustrated in FIG. **1**, the lip **172** may be annular and is sealingly contacted by the diaphragm portion **142** when the valve device **136** is in the closed position. A portion of the small diameter portion **168** and the large diameter portion **170** are disposed within the receiving portion **110**. In certain embodiments like those illustrated in FIGS. **7-9**, a retaining ring **167** may be received by an inner groove **171** provided adjacent an end of the large diameter portion **170**.

Referring back to FIG. **2**, the small diameter portion **168** may be of a cylindrical shape and has a wall portion **174** that defines the first perforation **132**. The large diameter portion **170** may be of a cylindrical shape and defines a second perforation **175**. The first perforation **132** is of a diameter which is less than that of the second perforation **175**. In the embodiments illustrated in FIGS. **1** and **2**, the first perforation **132** is of a substantially constant diameter adjacent the lip **172** and includes a filleted end portion **177** adjacent a biasing member **176**. In the embodiments illustrated in FIGS. **8** and **9**, the first perforation **132** is of a substantially constant diameter adjacent the lip **172** and includes a tapered diameter portion **173** adjacent the biasing member **176**. The tapered diameter portion **173** improves the flow of pressurized air through the first perforation **132** when the tire pressure is being decreased as is represented in FIG. **9**. The tapered diameter portion **173** is formed by a surface of the wall portion **174**. Preferably, the surface is provided at an angle. The angle of the surface relative to a centerline **180** is selected to provide an area **A1** in a predetermined position within the first perforation **132**.

An end **232** of the biasing member **176** is received in a groove **234** formed radially between the small diameter portion **168** and large diameter portion **170**. The groove **234** is an annular recess of a depth which allows the biasing member **176** to undergo a selected amount of compression if, as is shown in FIG. **9**, the base **212** contacts the first housing **160**.

In the embodiments illustrated in FIGS. **7-9**, the first housing **160** comprises an inner face **236**. The wall portion **174** is attached to the inner face **236** on an end thereof. The inner face **236** is an annular portion and separates the first perforation **132** from the groove **234**. At an outer edge thereof, the inner face **236** is attached to an inner wall portion **238**. The inner wall portion **238** is attached to an upper wall portion **240** at an outer edge thereof. The upper wall portion **240** is substantially annular. The upper wall portion **240** is attached to an outer wall portion **242** at an outer edge thereof. The inner wall portion **238**, upper wall portion **240** and outer wall portion **242** define the groove **234**.

Referring back to FIG. **1**, the valve assembly **100** comprises the biasing member **176**. Preferably, the biasing member **176** is resilient and a spring such as, for example, a coil spring formed from a spring steel. The biasing member **176** is disposed adjacent the first perforation **132**.

The biasing member **176** and a valve member **178**, **178**A, **178**B, **178**C are disposed within the cavity **134**. The cavity **134** is defined by the receiving portion **110** and the first housing **160**. The valve member **178**, **178**A, **178**B, **187**C is movable within the cavity **134** and first housing **160**. In an embodiment, the valve member **178**, **178**A, **178**B, **178**C is slidably disposed within the cavity **134** and first housing **160**. The biasing member **176** contacts the valve member **178**, **178**A, **178**B, **178**C and biases the valve member **178**, **178**A, **178**B, **178**C away from the first perforation **132** and toward the second port **128**.

The fluid conduit **126** connects the tire port **124** to the second port **128** allowing the second fluid conduit **133**, cavity **134**, first perforation **132** and first port **130** to be in fluid communication with the wheel assembly. When the tire pressure is being decreased, the valve member **178**, **178**A, **178**B, **178**C is movable toward or away from the first port **130** in response to a flow of air from the second port **128**. Generally, as the tire pressure decreases, the valve member **178**, **178**A, **178**B, **178**C moves away from the first port **130**.

The first housing **160**, biasing member **176**, and valve member **178**, **178**A, **178**B, **178**C preferably share a common centerline **180**. The second port **128** and tire port **124** may be offset from the centerline **180**. The biasing member **176** is at least partially received by the second perforation **175** and in contact therewith. A portion of the biasing member **176** may be received by the valve member **178**, **178**A, **178**B, **178**C and portions of the valve member **178**, **178**A, **178**B, **178**C and biasing member **176** may be engaged.

As best shown in FIGS. **3**, **5-6**, and **7-8** the valve member **178**, **178**A, **178**B, **178**C comprises a first portion **182**, **182**A, **182**B, **182**C and a second portion **184**, **185**, **185**C. The first portion **182**, **182**A, **182**B, **182**C and second portion **184**, **185**, **185**C are concentric. The first portion **182**, **182**A, **182**B, **182**C is attached to the second portion **184**, **185**, **185**C adjacent a first end **186** thereof. In an embodiment, the first portion **182**, **182**A, **182**B, **182**C has a diameter which is less than the second portion **184**, **185**, **185**C.

The first portion **182**, **182**A, **182**B, **182**C comprises an outer surface **188** which is unbroken adjacent a second end **190** to allow a pressurized fluid to flow over it. The first port **130** communicates with the second port **128** via a flow pathway formed around the outer surface **188**. The first portion **182**, **182**A, **182**B, **182**C has a diameter which gradually reduces toward the second end **190**.

As illustrated best in FIGS. **3**, **5** and **6**, the second end **190** may be sharply defined. In other embodiments, the second end may have a domed shape. The second end **190** comprises a second end surface **248**. In an embodiment like the one illustrated in FIG. **3**, the second end surface **248** is unbroken and of a generally circular shape. In other embodiments, such as the one shown in FIG. **7**, the second end surface **248** has an annular shape and surrounds an opening **250**. The opening **250** may be of a circular shape and in fluid communication with a channel **252** which extends through the first portion **182**C from the second end **190** to the first end **186**. In one embodiment, such as the one shown in FIG. **7**, the first portion **182**C can be a top frusto-conical first portion **182**C having a continuous outer surface **188** allowing pressurized fluid to flow between the first housing **150** and the valve member **178**C and through the channel **252**.

The channel **252** allows for the communication of pressurized air from the second end **190** to the first end **186** and vice versa. When decreasing the tire pressure, the flow of pressurized air through at least a portion of the channel **252** is preferably non-turbulent. The channel **252** may have a generally cylindrical shape and be of a diameter **254** which is substantially constant adjacent the second end **190** of the first portion **182**C. The diameter **254** may increase towards and adjacent the first end **186** of the first portion **182**C.

An area A**2** is formed in the channel **252**. The area A**2** is of a diameter and size which is constant. When the tire pressure is being decreased, the area A**2** allows for a minimum flow capacity through the valve assembly **100**. Preferably, when decreasing the tire pressure, the flow of pressurized air through the area A**2** is non-turbulent.

In certain embodiments which are illustrated in FIGS. **4-6**, the first end **186** is also attached to a first end portion **192**. In this embodiment, the first end portion **192** is attached to a middle diameter portion **194**. The first end portion **192** and middle diameter portion **196** may each be of an annular shape.

One or more openings **196** may be provided in a cylindrical portion **210**. In the embodiments illustrated in FIGS. **4-6**, the cylindrical portion **210** is which is attached to the middle diameter portion **194**. As shown, the one or more openings **196** may comprise four openings. The one or more openings **196** extend from the outer surface **188** to a cavity portion **198** defined by an inner surface **200**. The cavity portion **198** may increase in thickness towards the tire port **124**. As shown in FIG. **6**, the one or more openings **196** may be formed at right angles to each other and/or in a perpendicular relationship with the centerline **180** of the valve member **178**B. In another embodiment which is shown in FIG. **5**, the one or more openings **196** may be formed at an acute angle to the centerline **180** of the valve member **178**A. As illustrated in FIG. **3**, in other embodiments the valve member **178** comprises a first portion **182** which is unbroken to the second portion **184** such that the fluid directed through the valve assembly **100** flows around the first portion **182** rather than through one or more openings provided therein.

In other embodiments, such as those illustrated in FIGS. **7-9**, a bottom rounded portion **199** having a continuous outer surface **244** is attached to the first end **186**. The bottom rounded portion **199** is attached to a tapered portion **201**. The tapered portion **201** separates the bottom rounded portion **199** from an orifice portion **202**. The tapered portion **201** reduces in thickness towards the bottom rounded portion **199**. Reducing the thickness of the tapered portion **201** decreases flow restrictions experienced by the pressurized air adjacent the tapered portion **201**. The bottom rounded portion **199** and tapered portion **201** each comprise a curvilinear outer surface **244**, **246**.

The first portion **182**, **182**A, **182**B, **182**C also comprises the orifice portion **202**. The orifice portion **104** comprises two or more discrete portions. In an embodiment, the orifice portion **202** comprises a first diameter portion **204** and a second diameter portion **206**. In other embodiments, the orifice portion **202** also comprises an intermediate diameter portion **208**. The first diameter portion **204** is of a diameter which is greater than that of the second diameter portion **206**. The intermediate diameter portion **208** is of a diameter which is greater than that of the second diameter portion **206** and less than that of the first diameter portion **204**.

The first diameter portion **204** is attached to the intermediate diameter portion **208** which is attached to the second diameter portion **206**. The first diameter portion **204** may also be attached to and separate the intermediate diameter portion **208** and second diameter portion **204** from the cylindrical portion **210**. The second diameter portion **206** is attached to the second end **190** of the first portion **182**, **182**A, **182**B, **182**C. The first diameter portion **204** and intermediate diameter portion **208** reduce in diameter toward the second diameter portion **204**. The first diameter portion **204**, intermediate diameter portion **208**, and second diameter portion **206** may be each of a general frustoconical shape with each portion **204**, **206**, **208** gradually reducing in diameter toward the second end **190**. Although not shown in the embodiments illustrated in FIGS. **7-9**, the first portion **182**C illustrated therein may also comprise an intermediate diameter as described above.

The second portion **184**, **185**, **185**C may be disposed in the receiving portion **110**. Under certain conditions, the second portion **185**, **185**C may contact the first housing **160** to provide a positive stop. In certain embodiments which are shown in FIGS. **4-9**, the second portion **185** comprises a base **212** and a wall **214**. The wall **214** is annular and is preferably disposed around the base **212**. In the embodiments illustrated in FIGS. **4-6**, the wall **214** also extends axially beyond the base **212** toward the first perforation **132**. However, in the embodiments illustrated in FIGS. **7-9**, the base **212** extends axially beyond the wall **214** toward the first perforation **132**.

In other embodiments like those illustrated in FIGS. **8** and **9**, the valve member **178**C is held within the first housing **160** by the retaining ring **167**. In these embodiments, an inner diameter **215** of the retaining ring **167** is smaller than an outer diameter **219** of the wall **212**. Also, the outer diameter **219** of the wall **212** is greater than the diameter of the first perforation **132**. However, the outer diameter **219** of the wall **212** is smaller than the diameter of the second perforation **175**.

The base **212** is positioned adjacent the second port **128**. The second portion **185**, **185**C receives a portion of the biasing member **176**. In the embodiments illustrated in FIGS. **4-6**, the biasing member **176** contacts the base **212** and is disposed between the wall **214** and the first end portion **192** of the valve member **178**A, **178**B. Also, in the embodiments illustrated in FIGS. **4-6**, the base **212** is a solid member. In other embodiments such as those illustrated in FIGS. **7-9**, the biasing member **176** contacts the wall **214** and is disposed around the base **212**.

In the embodiments illustrated in FIGS. **7-9**, one or more holes **213** are provided in the base **212** to allow pressurized air to flow therethrough. In these embodiments, three holes **213** may be provided. Each hole **213** is defined by one or more curvilinear surfaces **244** which reduces the amount of resistance experienced by the pressurized air flowing through the one or more holes **213**.

The one or more holes **213** provide an area for pressurized air to flow through which is greater in size than the area A**1**. The size of the area A**1** may vary depending on the tire pressure and the desired decrease in tire pressure. The size of the area A**1** may increase as the tire pressure decreases to maintain or substantially maintain a selected flow capacity. Creating an area for the flow of pressurized air through the base **212** via the one or more holes **231** which is greater in size than the area A**1** ensures that the area A**1** is the location of restricted flow through the valve assembly **100**.

In other embodiments like the one shown in FIG. **3**, the second portion **184** comprises one or more supports **216**. The supports **216** are attached to, disposed about and extend radially beyond the first portion **182**. Preferably, the supports **216** are equally spaced apart. Each support **216** may have a generally wedge-shaped portion **218**. Each of the supports **216** comprises an upper edge **220** that is sharply defined. A definition of the upper edges **220** may be defined by the process used to form the supports **216**. When the tire pressure is being adjusted, spaces **228** between successive shuttle supports **216** form a portion of a flow pathway through the valve assembly **100**.

Each of the supports **216** is positioned adjacent a lower wall portion **226** and the second port **128**. The supports **216** define an outer diameter **222** of the valve member **178**. As shown in FIG. **1**, the outer diameter **222** is smaller than an inner diameter **224** of the first housing **160**.

The valve assembly **100** comprises the area A**1**. When the tire pressure is being decreased, the area A**1** allows the valve assembly **100** to provide a selected flow capacity therethrough. In the embodiments illustrated in FIGS. **1-6**, the flow capacity through the valve assembly **100** is equal to the flow capacity through the area A**1**. In the embodiments illustrated in FIGS. **7-9**, the flow capacity through the valve assembly **100** is equal to the flow capacity through the area A**1** and the flow capacity through the area A**2**. In the embodiments illustrated in FIGS. **1-6**, the area A**1** has a flow capacity when the tire pressure is being decreased which provides the pressure necessary for the valve assembly **100** to remain open and to close when the selected tire pressure is achieved. In the embodiments illustrated in FIGS. **7-9**, the area A**1** and the area A**2** have flow capacities when the tire pressure is being decreased which provide the pressure necessary for the valve assembly **100** to remain open and to close when the selected tire pressure is achieved.

The area A**1** is formed in the first perforation **132**. The area A**1** is at least partially defined by the wall portion **174** of the first housing **160**. Area A**1** is illustrated in FIG. **16** when it is defined solely by the wall portion **174**. Area A**1** is defined solely by the wall portion **174** when the tire pressure is not being decreased or when the tire pressure is being decreased but is low. When the tire pressure is being decreased, the area A**1** may also be defined by a portion **204**, **206**, **208** of the first portion **182**, **182**A, **182**B, **182**C.

Operation of the embodiments of the valve assembly **100** illustrated in FIGS. **1-9** when the tire pressure is decreased will now be described utilizing FIGS. **10-16**.

To decrease the tire pressure, a flow of air is directed to the valve assembly **100** from the air compressor. The flow of air is at a pressure which is greater than the tire pressure. The flow of air enters the major chamber **114** from the control port **118** via the major fluid conduit **120**. The flow of air moves the valve device **136** to the open position by biasing the diaphragm portion **142** away from the tire port **124** as is shown in FIGS. **10-12**.

Once the valve device **136** is in the open position, fluid communication between the air compressor and valve assembly **100** is stopped and the flow of air from the air compressor is discontinued. Next, air enters the valve assembly **100** from the wheel assembly through the tire port **124**. From the tire port **124**, the pressurized air flows through the cavity **134** via the second port **128** and fluid conduits **126**, **133** around the valve member **178** through the first perforation **132** to the first port **130**, and to the major chamber **114** and out the control port **118**.

When the pressurized air from the wheel assembly flows through the cavity **134**, the pressurized air provides a bias to the valve member **178**. The bias provided by the pressurized air opposes the bias provided by the biasing member **176** which urges the valve member **178** toward the first perforation **132**. As shown in FIGS. **10-12**, urging the valve member **178** toward the first perforation **132** compresses the biasing member **176** and may position the valve member **178** within the first perforation **132**. When the valve member **178** is positioned within the first perforation **132**, a portion **204-208** of the first portion **182** also defines the area A**1**. As the tire pressure decreases, the bias provided to the valve member **178** by the pressurized air is reduced and the biasing member **76** urges the valve member **178** back toward the tire port **124**.

The tire pressure determines which portion **204-208** of the first portion **182**, if any, is received by the first perforation **132**. Thus, when the tire pressure is decreased, area A**1** may vary in size depending on the initial tire pressure and the selected tire pressure. When the tire pressure is high as described below and represented in FIG. **13**, the area A**1** is smaller than when the tire pressure is lower as described below for and illustrated by FIGS. **14-16**. Also, as is illustrated by FIGS. **13-16**, the size of the area A**1** increases as the tire pressure decreases. Increasing the size of the area A**1** as the tire pressure decreases allows the flow capacity through area A**1** to remain substantially constant.

Referring now to FIGS. **13-16**, the area A**1** will be described with reference to certain tire pressure conditions and the tire pressure decreasing.

A representation of a high tire pressure condition is illustrated in FIG. **13**. Under a high tire pressure condition such as, for example, a tire pressure of 150 psi, the first diameter portion **204** is received by the first perforation **132** and the area A**1** is defined by the first diameter portion **204** and the wall portion **174**. FIG. **14** illustrates area A**1** when tire pressure is lower than under the tire pressure condition described above and illustrated by FIG. **13**. In this embodiment, the intermediate diameter portion **208** is received by the first perforation **132** and the area A**1** is defined by the intermediate diameter portion **208** and the wall portion **174**. FIG. **15** illustrates area A**1** when tire pressure is lower than under the conditions described above and illustrated by FIGS. **13** and **14**. In this embodiment, the second diameter portion **206** is received by the first perforation **132** and the area A**1** is defined by the second diameter portion **206** and the wall portion **174**. FIG. **16** illustrates area A**1** when tire pressure is not being decreased or is lower than the tire pressure conditions described above and illustrated by FIGS. **13-15**. As illustrated in FIG. **16**, the first portion **182** is not received by the first perforation **132**. Under the conditions described above and illustrated by FIG. **16**, the bias provided by the pressurized air is not greater than the opposing bias provided by the biasing member **176** to the valve member **178**. Instead, the first portion **182** is received by the second perforation **175** and the area A1 is defined solely by the wall portion **174** of the first housing **160**.

In the embodiments of the valve assembly **300**, **500** illustrated in FIGS. **17-23**, the valve assembly **300**, **500** is not attached to the wheel assembly. In these embodiments, the valve assembly **300**, **500** is provided at another portion of the vehicle and attached to a pneumatic control unit **310**, **512** of the central tire inflation system. However, the embodiments of the valve assembly **300**, **500** still allow for an optimized decrease in tire pressure and may also facilitate venting the central tire inflation system. In these embodiments, when the tire pressure is being decreased, the valve assembly **300**, **500** is configured to control pressure in one or more portions of the tire inflation system.

The embodiments of the valve assembly **300**, **500** will be described for use in decreasing the tire pressure of one wheel assembly. However, the valve assembly and central tire inflation system are not so limited. Thus, the valve assembly and central tire inflation system may be utilized to simultaneously decrease the tire pressures of more than one wheel assembly.

Embodiments of the valve assembly **300** will now be described with reference to FIGS. **17-19**. Certain embodiments of the valve assembly **300** may be as described above for embodiments of the valve assembly **100** illustrated in FIGS. **1-16**.

The valve assembly **300** comprises a first housing **302**. The first housing **302** has a first port **304** connected to a second port **306** via a cavity **308**. In these embodiments, the second port **306** is selectively in fluid communication with a wheel assembly. The wheel assembly is as above-described. The second port **306** is in fluid communication with the wheel assembly when the tire pressure of the wheel assembly is being decreased.

The valve assembly **300** via the second port **306** is in fluid communication with a port formed in the pneumatic control unit **310**. The valve assembly **300** is selectively in fluid communication with the wheel assembly via the second port **306**, pneumatic control unit **310** and other portions of the central tire inflation system. In these embodiments, a valve device **312** is in fluid communication with the valve assembly **300** and the pneumatic control unit **310**. The valve device **312** is operable from an open position to a closed position and vice versa. The valve device **312** allows or prevents fluid communication between the valve assembly **300** and pneumatic control unit **310**. Fluid communication between the valve assembly **300** and the pneumatic control unit **310** is achieved by placing the valve device **312** in the open position.

In the open position, the valve device **312** allows the valve assembly **300** via the pneumatic control unit **310** to vent a portion of the tire inflation system or communicate with the wheel assembly to decrease the tire pressure thereof as described above. In the open position, the valve device **312** allows fluid communication between the valve assembly **300** and a source of pressurized air such as the wheel assembly. In the closed position, the valve device prevents fluid communication between the valve assembly **300** and a source of pressurized air such as an air compressor. As illustrated in FIG. **14**, the valve device **312** is preferably of the solenoid variety. It is also preferred that the valve device **312** is normally in the open position.

Referring now to FIGS. **18-19**, the cavity **308** is defined by inner surfaces **314** of the first housing **302**. The cavity **308** may have a generally cylindrical shape. The second port **306** is in fluid communication with the cavity **308** on an end **316** thereof. The second port **306** is connected to and in fluid communication with a tire port **318** via a fluid conduit **320** formed in the first housing **302**. A second fluid conduit **321** connects the second port **306** to the cavity **308**. When the valve device **312** is in the open position and the tire pressure is being decreased, the wheel assembly is in fluid communication with the second port **306** via the tire port **318**, the fluid conduit **320** and the second fluid conduit **321**. The fluid conduit **320** preferably has a threaded connection portion for attaching the valve assembly **300** to the pneumatic control unit **310**.

On an opposite end **324**, the cavity **308** is in fluid communication with the first port **304**. In these embodiments, the first port **304** is also in fluid communication with the atmosphere. Air within the wheel assembly is expelled through the first port **304** when the tire pressure is being decreased. Also, pressurized air within the central tire inflation system is expelled through the first port **304** when venting the system.

A biasing member **326** is disposed in the cavity **308** adjacent a first perforation **328**. The first perforation **328** is positioned between the first port **304** and the cavity **308** and is in fluid communication therewith. The first perforation **328** is formed in the first housing **302** and is preferably as described above for the embodiments of the valve assembly **100** illustrated in FIGS. **1-16**. The first perforation **328** is defined by a wall portion **329**.

An end **330** of the biasing member **326** contacts the inner surface **314** of the first housing **302** adjacent the first perforation **328**. Preferably, the biasing member **228** is as described above and a spring such as, for example, a coil spring which operates as described above for the embodiments of the valve assembly **100** illustrated in FIGS. **1-16**.

A valve member **332** is also disposed in the cavity **308** and is contacted by an end **334** of the biasing member **326**. A portion of the biasing member **326** and a portion of the valve member **332** are engaged. The tire port **318**, second port **306**, valve member **332**, biasing member **326**, first perforation **328** and first port **304** are axially aligned.

The valve member **332** may be as described above for the embodiments of the valve assembly **100** illustrated in FIGS. **1-16**. The valve member **332** comprises a first portion **336** and a second portion **338**. In an embodiment, the first portion **336** has a diameter which is less than the second portion **338**. The first perforation **328** is sized to receive the first portion **336**. The first portion **336** has an outer surface **340** which is unbroken adjacent an end **342** to allow a pressurized fluid to flow around it. The first portion **336** reduces in diameter toward the end **342** thereof.

The first portion **336** comprises an orifice portion **344**. The orifice portion **344** may be as described above for the embodiments of the valve assembly **100** illustrated in FIGS. **1-16**. The orifice portion **344** comprises a first diameter portion **346** and a second diameter portion **348**. The first diameter portion **346** has a diameter which is greater than the small diameter portion **348**. The first diameter portion **346** and the second diameter portion **348** gradually reduce in diameter toward the end **342** of the first portion **336**. As the first portion **336** gradually reduces in diameter, the flow rate through the valve assembly **300** does not rapidly drop even as the tire pressure is decreased over time as described above. A cylindrical portion **350** is attached to the first diameter portion **346** on an end and the second portion **338** on an opposite end.

The second portion **338** may be as described above for the embodiments of the valve assembly **100** illustrated in FIGS. **1-16**. In the embodiments illustrated in FIGS. **17-19**, the second portion **338** comprises a plurality of supports **352** which are circumferentially and equally spaced apart. Each support **352** extends from the first portion **336**. The supports **352** contact the inner surface **314** of the first housing **302** and are positioned adjacent the second port **306**. Preferably, the supports **352** are similarly sized and spaced apart. A space **354** is provided between adjacent supports **352** and sized to allow a desired amount of air to flow therethrough. Preferably, the spaces **354** are similarly sized. The valve member **332** may also comprise at least one spacer (not depicted) provided on an end surface **356** of each support **352**. The spacer(s) provide gaps between the inner surface **314** of the first housing **302** and the second portion **338**.

The valve assembly **300** comprises an area A**1**. The area A**1** may be as described above for the embodiments of the valve assembly **100** illustrated in FIGS. **1-16** and the area A**1** described above for the embodiments of the valve assembly **100** may be as described below. The size of area A**1** varies between embodiments of the valve assembly **300**. The area A**1** is at least partially defined by the wall portion **329** which defines the first perforation **328**.

The flow capacity through area A**1** can be selected. Preferably, for the embodiments of the valve assembly **300**, **500** illustrated in FIGS. **17-23**, the area A**1** has a flow capacity which is less than a flow capacity through another portion of the system such as, for example, a wheel valve. Preferably, the area A**1** has a flow capacity which is less than the flow capacity through a selected area of the wheel valve. Since the area A**1** has a flow capacity which is less than a flow capacity through the wheel valve, the pressure necessary for the wheel valve to remain open when the tire pressure is being decreased is provided.

When tire pressure is being decreased or pressure within the system is being vented, pressurized air enters the valve assembly **300** through the second port **306** and flows through the cavity **308** to the first port **304** via a flow pathway formed around the first portion **336**. The pressurized air entering the cavity **308** provides a bias to the valve member **332** which opposes the bias provided by the biasing member **326** and urges the valve member **332** toward the biasing member **326** and the first port **304** as described above. As described above, under certain tire pressure conditions, the valve member **332** is urged toward the first port **304**, the biasing member **326** is compressed and the valve member **332** is received by the first perforation **328**. When the first perforation **328** receives the valve member **332**, the area A**1** is defined by a portion **346**, **348** of the first portion **336** and wall portion **329**.

As the tire pressure decreases, the bias provided by the pressurized air is reduced. As the bias is reduced, the biasing member **326** urges the valve member **332** back toward the second port **306** as described above. As the valve member **332** moves toward the second port **306**, the area A**1** increases in size. For example, when defined by the second diameter portion **348**, the area A**1** is of a size which is larger than when it is defined by the first diameter portion **346**. As the size of area A**1** increases, the flow capacity through area A**1** and the pressure desired in a selected portion of the tire inflation system can remain substantially constant even though the tire pressure is reduced.

Embodiments of the valve assembly **500** will be described with reference to FIGS. **20-23**. Certain embodiments of the valve assembly **500** may be as described above for embodiments of the valve assemblies **100**, **300** illustrated in FIGS. **1-19**.

The valve assembly **500** comprises a first housing **502**. The first housing **502** has a first port **504** connected to a second port **506** via a cavity **508**. In this embodiment, the second port **506** is selectively in fluid communication with a wheel assembly. The wheel assembly is as described above. However, it should be appreciated that the valve assembly **500** may selectively communicate with each wheel valve assembly in fluid communication with the central tire inflation system. The second port **506** is in fluid communication with the wheel assembly when the tire pressure of the wheel assembly is being decreased.

The valve assembly **500** via the second port **506** is in fluid communication with a tire port **510** formed in a pneumatic control unit **512**. In these embodiments, the first housing **502**, second port **506**, tire port **510** are formed in a unitary manner with the pneumatic control unit **512**. A fluid conduit **514** is formed in the pneumatic control unit **512** and connects the ports **506**, **510** to enable fluid communication between the valve assembly **500** and a valve device **516**.

The valve assembly **500** is selectively in fluid communication with the wheel assembly via the valve device **516**, pneumatic control unit **512** and other portions of the central tire inflation system. The valve device **516** may be as described above for the embodiments of the valve assembly **300** illustrated in FIGS. **17-19**. The valve device **516** is operable from an open position to a closed position and vice versa. The valve device **516** selectively allows and prevents fluid communication between the valve assembly **500** and the pneumatic control unit **512** and other portions of tire inflation system. Fluid communication between the valve assembly **500** and pneumatic control unit **512** is achieved by placing the valve device **516** in the open position.

In the open position, the valve device **516** may allow the valve assembly **500** via the pneumatic control unit **512** to vent a portion of the tire inflation system or communicate with the wheel assembly to decrease the tire pressure thereof. Also, in the open position, the valve device **516** allows fluid communication between the valve assembly **500** and a source of pressurized air such as the wheel assembly. In the closed position, the valve device **516** prevents fluid communication between the valve assembly **500** and a source of pressurized air such as an air compressor. In these embodiments, the valve device **516** is preferably of the solenoid variety. It is also preferred that the valve device **516** is normally in the open position.

The cavity **508** is defined by inner surfaces **516** of the first housing **502**. The cavity **508** may have a generally cylindrical shape in cross-section. The second port **506** is in fluid communication with the cavity **508** via a first perforation **518**.

On an opposite end **520**, the cavity **508** is in fluid communication with the first port **504**. The first port **504** may be as described above for the embodiments of the valve assembly **300** illustrated in FIGS. **17-19**. The first port **504** is in fluid communication with the atmosphere. Air within the wheel assembly is expelled to the atmosphere through the first port **504** when the tire pressure is being reduced. Also, air within the central tire inflation system is expelled through the first port **504** when pressure within the system is being vented as described above.

A biasing member **522** is disposed in the cavity **508** adjacent the first perforation **518**. The first perforation **518** is formed in the first housing **502**. The first perforation **518** is in fluid communication with the fluid conduit **514** via the second port **506**. The first perforation **518** comprises a wall portion **524** which at least partially defines an area A**1**. In these embodiments, the first perforation **518** is tapered and reduces in thickness toward the second port **506**.

In these embodiments, the first perforation **518** separates the cavity **508** from the fluid conduit **514**. Preferably, a motor assembly **526** is attached to the pneumatic control unit **512** and a portion thereof is received by the cavity **508**. Preferably, the motor assembly **526** comprises a motor which is of the stepper variety.

Referring now to FIGS. **20-23**, the biasing member **522** is disposed around a cylindrical shaft portion **528** which extends from the motor assembly **526** into the cavity **508**. The motor assembly **526** incrementally extends and retracts the shaft portion **528**. When the tire pressure is being decreased, the motor assembly **526** receives a signal which causes the shaft portion **528** to be extended or retracted. The shaft portion **528** is attached to a valve member **530** which is extended or retracted by the motor assembly **526** via the shaft portion **528**. The valve member **530** is aligned with the shaft portion **528**.

The valve member **530** comprises a first portion **532** which has an outer surface **534** which is unbroken to allow air to flow around it. The first portion **532** may have a generally frusto-conical shape and reduces in diameter toward an end **536** thereof. The first portion comprises an orifice portion **538**. The orifice portion **538** may be as described above for the embodiments of the valve assembly **100**, **300** illustrated in FIGS. **1-19**. The first portion comprises a first diameter portion **540** and a second diameter portion **542**. The second diameter portion **542** is provided adjacent the fluid conduit **514**. In an embodiment, the first diameter portion **540** has a diameter which is greater than a diameter of the second diameter portion **542**. The second diameter portion **542** reduces in diameter toward the end **520** of the first portion **532**.

The first portion **532** gradually reduces in diameter from the first diameter portion **540** to the second diameter portion **542**. The reduction in diameter from the first diameter portion **540** to the second diameter portion **542** is of a steepness (relative to the centerline) which is selectable. Preferably, the steepness is selected based on the maximum tire pressure. For example, at a maximum tire pressure of 100 psi or more, the steepness may be selected to be greater than the steepness when the maximum tire pressure is less than 100 psi.

The area A**1** is formed in the first perforation **518**. The first portion **532** may be received by the first perforation **518**. When received by the first perforation **518**, a portion **540**, **542** of the first portion **532** and wall portion **524** define the area A**1** as described above. The area A**1** may be as described above. The first portion **532** is positioned relative to the wall portion **524** to define the area A**1**.

When the tire pressure is being decreased, the wheel assembly is in fluid communication with a wheel valve which is preferably attached to the wheel assembly and selectively in fluid communication with the pneumatic control unit **512**. As described above for the embodiments of the valve assembly **300** illustrated in FIGS. **17-19**, air within the wheel assembly flows through the area A**1** when the tire pressure is being decreased. As described above, the area A**1** has a flow capacity which is less than the flow capacity through a selected area of the wheel valve. If two or more wheel assemblies are having their tire pressures decreased, the area A**1** has a flow capacity which is less than the flow capacity through the sum of the selected areas of the wheel valves. In certain embodiments, area A**1** has a flow capacity which is about 85 percent or less of the flow capacity through the selected area of the wheel valve. Preferably, area A**1** has a flow capacity which is about 75 percent of the flow capacity through the selected area of the wheel valve. Since area A**1** has a flow capacity which is less than the flow capacity through the selected area of the wheel valve, the pressure needed for the wheel valve or wheel valve assemblies to remain in the open position is provided as the tire pressure is being decreased.

With reference to FIGS. **21-23**, the area A**1** is of a size which varies depending on the tire pressure as described above. When the tire pressure is being decreased, a signal which depends on the tire pressure is received by the motor assembly **526**. The signal causes the motor assembly **526** to extend or retract the valve member **530** via the shaft portion **528**. The motor assembly **526** incrementally extends and retracts the valve member **530** to increase or decrease the size of the area A**1**. Preferably, the length of the increment that the valve member **530** extends or retracts is predetermined.

As the tire pressure is decreased, the valve member **530** is generally retracted toward the cavity **508** to increase the size of area A**1** so that the flow capacity through the area A**1** is substantially maintained and the pressure to maintain the wheel valve in the open position is provided. Thus, in these embodiments, the valve assembly **500** controls the flow capacity through the area A**1** and the pressure in the central tire inflation system to maintain the wheel valve assembly in the open position as the tire pressure is decreased.

A guide rod **544** is attached to the end **536** of the valve member **530**. The guide rod **544** extends through the second port **506** and into the pneumatic control unit **512**. The guide rod **544** is aligned with the centerline **546** of the valve member **530** and the shaft portion **528**. The guide rod **544** allows the valve member **530** to maintain its position relative to the wall portion **524** so that the area A**1** is uniform.

In accordance with the provisions of the patent statutes, the present invention has been described in what is considered to represent its preferred embodiments. However, it should be noted that the invention can be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.

What we claim is:

1. A valve assembly for a central tire inflation system, comprising:

- a first housing having a first port connected to a second port via a cavity, wherein the second port is in fluid communication with a wheel assembly;
- a biasing member disposed in the cavity adjacent a first perforation formed in the first housing; and
- a valve member contacted by the biasing member, the valve member comprising a top frusto-conical portion having a continuous outer surface connected to a bottom rounded portion having a continuous outer surface, a first end connected to the bottom rounded portion and a second end connected to the top frusto-conical portion wherein the second end has an opening therein providing for a single channel extending through the valve member from the second end to the first end to allow a pressurized fluid to flow between the housing and the outer surface of the valve member and through the channel.

2. The valve assembly of claim **1**, wherein the top frusto-conical portion reduced in diameter toward the second end.

3. The valve assembly of claim **1**, wherein the biasing member biases the valve member away from the first perforation and toward the second port.

4. The valve assembly of claim **1**, wherein the first perforation is sized to receive the top frusto-conical portion.

5. The valve assembly of claim **1**, wherein the top frusto-conical portion comprises a first diameter portion and a second diameter portion, the first diameter portion being of a diameter which is greater than that of the second diameter portion and gradually reducing in diameter toward the second diameter portion which gradually reduces in diameter toward the second end.

6. The valve assembly of claim **1**, wherein the first port is in fluid communication with the second port via a flow pathway formed between the housing and the outer surfaces of the valve member and through the channel.

7. The valve assembly of claim 1, wherein a pressurized air biases the valve member and opposes a bias provided by the biasing member to the valve member.

8. The valve assembly of claim 1, further comprising an area formed in the first perforation which varies in size depending on tire pressure.

9. The valve assembly of claim 8, wherein the area is defined by an inner wall portion of the housing and the top frusto-conical portion of the valve member.

10. The valve assembly of claim 8, wherein the area increases in size as the tire pressure decreases.

11. The valve assembly of claim 9, wherein the area is defined by the outer surface of the top frusto-conical portion.

12. The valve assembly of claim 1, wherein the first housing is positioned within a second housing which comprises a control port and a tire port.

13. The valve assembly of claim 12, further comprising a valve device in fluid communication with the control port and the first perforation, the valve device positioned within the second housing operable between an open position and a closed position which allows or prevents fluid communication between the control port and tire port, respectively.

14. The valve assembly of claim 13, further comprising a major biasing member which biases the valve device to the closed position.

15. The valve assembly of claim 14, wherein the major biasing member and biasing member each comprise a spring.

16. The valve assembly of claim 1, further comprising a valve device in fluid communication with the valve assembly which selectively prevents fluid communication between the valve assembly and a source of pressurized air.

17. The valve assembly of claim 16, wherein the source of pressurized air is an air compressor or a wheel assembly.

18. The valve assembly of claim 16, wherein pressurized air is communicated to the valve assembly via the valve device and a fluid conduit.

19. A wheel valve assembly as defined by claim 1.

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